

THE Malayan Agricultural Journal

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EDITORIAL

We publish in this issue a further article in the series "Animal Husbandry in Malaya." This article deals with the improvement of cattle and buffaloes in Malaya in continuation of the subject as treated in the April issue in which the selection of breeding stock in general was considered. Three main problems exist, nutrition, breeding, and disease, of which the first two are discussed in the present article.

The chief problem in connexion with nutrition is that of providing more cut fodder, and is closely linked up with basic agricultural practice in Malaya. Apart from padi it may be said that the major crops of this country are tree and bush crops, and practically no large grazing areas are at present available for cattle, and no extensive areas of land have been planted with fodder crops. Fertilisers are a necessity for the cultivation of many crops on Malaya's poor soils, and cattle manure provides a valuable form of fertiliser. Thus if we can increase the local cattle population we not only reduce imports of meat but we also provide increased supplies of cattle manure. Methods by which pasture and cut-fodders can be increased are considered by the authors who then proceed to the question of balanced rations, and show how, in the case of dairy cattle, such rations were compounded and fed at the Central Experimental Station, Serdang.

Generally speaking it may be said that improved nutrition must precede improvement by breeding, and it is recognised that a definite balance must be maintained between the two. The authors find that some degree of improvement by breeding is desirable in Malaya, and discuss the level of improvement to be aimed at and the common systems of breeding, with some reference to local conditions.

The general method by which a livestock owner should set about improving his stock is described, including the special problem of improving the Indian dairy cow. The article also draws attention to the important influence the technique of artificial insemination may exercise on livestock breeding throughout the world.

Mechanization. In this issue we introduce as a new feature the first quarterly progress report on the work carried out by the Department in its exploratory investigations into the possibilities of making use of mechanization in Malayan agriculture.

Mechanization is being widely discussed at the present time, and is receiving considerable publicity. It has already been emphasised in this Journal that recommendations can be made only as the result of careful experimentation, and while progress must not be unnecessarily slow, it must not be unduly hurried. It is felt desirable therefore to publish these progress reports to help readers in Malaya to appreciate that, even if no spectacular developments are announced, careful methodical work is being carried out by the Department.

Tea In our April issue we published an abstract of articles
Manufacture. published by the Tea Research Institute of Ceylon on tea manufacturing methods. We include in this number as a Selected Article under the title of "Some Modern Methods of Tea Manufacture" a further contribution to this subject and we think that it will be read with considerable interest by all who are associated with the tea industry.

The writer of the article very pertinently points out that the person most interested in the final product—the cup of tea—is the consumer. He goes on to question the belief that the consumer is concerned with the appearance of the tea in the packet and suggests that all that matters is the quality of the tea brewed and the number of cups of tea to be obtained from a given size of packet.

He considers that these requirements can be filled by quicker and cheaper manufacturing methods than those customary in present-day tea factories, and urges that the development of such methods should be considered by tea estates which have to instal new machinery as the result of the war.

Original Articles.

ANIMAL HUSBANDRY IN MALAYA (*Continued*)

4. The Improvement of Cattle and Buffaloes in Malaya

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General Considerations.

Livestock farming involves numerous problems, the most important of which are those connected with nutrition, breeding, health and control of disease, housing, general management, quality of products and by-products, and marketing organization. The livestock industry of any particular country may be backward in all or any of the above respects.

In investigating the possibilities of livestock improvement, it is necessary to examine the livestock industry of a country in all its different aspects and to assess the relative satisfactoriness of each. Then, since practical considerations, e.g. those of finance, usually operate to limit the research and extension facilities available, thus making it impossible to improve the industry simultaneously "on all fronts," the investigator must decide how the available resources may best be applied. In practice, after deciding which aspects of the industry are least satisfactory, i.e. after discovering the outstanding problems, the maximum results are usually achieved when the available research resources are concentrated on those problems.

The Chief Local Problems.

Sufficient information has been given in previous articles to show that, while questions of general management, housing, dairying practice and the like, undoubtedly require attention, the outstanding problems in Malaya, so far as "horned stock" are concerned, are those connected with nutrition, breeding and disease. These three aspects are to a considerable extent inter-related but questions of disease present a number of special problems and the reader will probably find it less confusing if these are deferred to a later article, leaving only nutrition and breeding to be considered at this stage.

Even with this simplification, treatment is not easy, for so many of the potential measures for improvement are as yet untested. Again, as was pointed out in the first article of this series, the future of the local livestock industries is inextricably linked to that of Malayan agriculture as

a whole, particularly so far as livestock expansion is concerned, and livestock improvement must therefore be considered from many different angles. The problem facing the padi-growing peasant will differ in its solution from that of his brother in the "tree crop" small-holding; the Indian herdsman is confronted with conditions that differ greatly from both, while labourers who wish to keep cattle on estates and the livestock-minded estate manager have both to consider factors which are special to the type of agriculture in which they are engaged. It is therefore impossible at present to be dogmatic as to the future of the local livestock industries and we must content ourselves by surveying the ground in a general rather than a special manner.

Some Nutritional Aspects of Livestock Improvement.

The question of improved nutrition can be studied intelligently only against a background of the broad facts enumerated below, which represent a summary of the relevant points culled from preceding sections.

- (a) Malayan agriculture is very largely concerned with tree crops (e.g. rubber and coconuts), bush crops (e.g. tea), and padi.
- (b) With few exceptions the soils of this country are poor. Despite this, past experience has shown that most tree and bush crops, when planted on virgin soil (cleared jungle), can flourish for many years without the application either of cattle manure or artificial fertilisers. This is due to a number of factors, e.g. (i) rapid weathering of local soils, (ii) small nutrient requirements of many local tree and bush crops, (iii) extensive root systems of such crops, (iv) high temperatures and ample rainfall. There are now signs, however, that sooner or later, except, perhaps, on some alluvial or Pahang Volcanic soils, a manurial programme becomes necessary on the average holding if yields are to be maintained. The question of manuring of padi lands on which the crop is almost entirely grown under "wet" cultivation is not discussed here.
- (c) Sooner or later, in the case of tree and bush crops, the question of replanting may have to be considered, and with replanting some form of a manurial programme is essential if the young crop is to make satisfactory growth. Typical programmes in the case of rubber, for instance, cover several years and may entail the application of considerable amounts of artificial fertilisers.
- (d) In addition to the manures or fertilisers required (i) by tree or bush crops on certain old-established areas and (ii) by replanted areas of such crops, we have to consider the short term crops, e.g. many fruits and vegetables. Such crops as a rule make considerable demands on the soil and fairly heavy dressings of manures or fertilisers are therefore required on most local soils if satisfactory returns are to be made and fertility maintained.

- (e) We see, therefore, that Malaya requires considerable quantities of manures or fertilisers, and that the big problem is—from what source or in what form can these requirements be met? There are, of course, a number of possibilities: artificial fertilisers, green manures, composts, alone or in association with each other. These may prove adequate and even economic under certain conditions, but there can be no doubt that the situation would be eased considerably if cattle manure were to be forthcoming in really large quantities. It should not be necessary to emphasise that such manure is really the basis of agriculture in all mixed-farming countries and that it is markedly superior to artificial fertilisers in some important respects.
- (f) Increased quantities of cattle manure for general agricultural use can be obtained by one or both of the following:—
 - (i) The introduction of better methods of conserving the manure that is already produced (e.g. better methods of collection and storage).
 - (ii) Increasing the local livestock population. Such a numerical increase is obviously desirable on other grounds, i.e. it would help to lessen our dependence on imported livestock products, e.g. beef and, possibly, ghee.
- (g) Cattle rearing on an expanded scale, either on a specialized basis, on estates, or as part of the Malay peasants' agricultural practice, depends on local ability to develop either greater areas of grazing lands or adequate and specialized fodder crop areas, or on both, since grass of one kind or another is the basic foodstuff of cattle and buffaloes. It may be mentioned at this stage that it is a common practice in parts of Ceylon and India to browse farm livestock in the jungle when ordinary pasturage becomes scanty or when the land is occupied by the rice crop. Under these conditions, also, farmers will often cut succulent growths from selected jungle trees for use as fodder. However, it is not possible at present to say how far practices of this nature can be introduced into Malayan livestock farming or what possibilities exist for the cultivation of succulent fodder bushes; hence we shall confine our attention to grass pasturage and cut grass fodders.

In view of the foregoing, we see that the outstanding nutritional problem is really that of providing more grass, in the form either of pastures or of cut fodders, with the question of supplementary concentrates taking second place. As one authority has put it, "cattle rearing on a national scale as part of the agricultural practice is conditioned by the finding of fodder crops which will grow under shade, for which there are not good prospects, or which will give fairly high yields in the open *with*

relatively small quantities of manure." The latter, of course, would allow the surplus manure to be used for general agricultural purposes.

Pastures and Cut Fodders.

Before considering the quantitative aspects of the problem it is essential for the reader to grasp the following points. Firstly, experience has shown that the pastures most suitable for the plains in this country are those comprised of mixtures of local grasses, e.g. *Axonopus compressus* (Savannah grass) and *Axonopus affinis* (carpet grass), *Paspalum conjugatum* ("cow grass," "rumput kerbau" or "rumput pahit"). Superior grasses may be discovered in future but these are the best known at present. Secondly, probably the most vigorous of all local grasses, lalang (*Imperata cylindrica*), unless carefully controlled tends to take possession of all well-drained exposed areas in this country and thus presents a considerable problem in pasture maintenance. To offset this it may be remarked that young lalang (up to about a month old) is fairly nutritious and that this, combined with its known palatability, suggests that greater use could and should be made of young lalang as a cut fodder for the feeding of livestock. Lastly, while on account of their high nutritive value certain legumes are used to a considerable extent in temperate countries for feeding livestock, little use is at present made of legumes for this purpose in Malaya. The chief reason for this is the low yield obtained on most Malayan soils, but the possibility of increasing legume cultivation for the feeding of livestock cannot be ruled out of potential future developments.

Turning now to the quantitative aspects of the problem we find that a cow under local conditions requires from 40 to 60 lbs. of cut grass a day, depending on its size, yield of milk, stage of gestation, quality of the available grazing areas, and so on. It has been estimated that to provide the whole of a cow's grass requirements by grazing, instead of part by grazing and part by cut fodders, the following areas would be required:—

- (a) Pasture composed almost entirely of good grazing grasses, 1 to 1½ acres per animal,
- (b) Rough, semi-scrub pasture, 2 to 3 acres per animal.

The maintenance of a pasture such as described in (a) above presents a number of difficulties under Malayan conditions. It is believed at present that such pastures can only be economically maintained here provided that they are put down under shade. In the full sun lalang tends to develop to a point where it virtually excludes all other grasses, and the control of lalang in such exposed pastures would normally be too costly a process. Observations suggest that moderate shade, in addition to inhibiting the growth of lalang, gives an increased yield and lushness in the case of the ordinary grazing grasses. In view of these considerations we may yet see the development of a system of cattle farming in Malaya based on pasture grazing in park-like lands, especially if it is found possible at the same time to provide the shade required by means of economic tree crops, such

as fruit trees, thus permitting a double revenue to be drawn from the same piece of land. It is possible, also, that such a system might conceivably produce a surplus of manure, especially if the pasture were to be given an occasional application of phosphatic fertiliser. A later article in this series will describe a successful system of cattle grazing under coconut palms and a second article on "Grassland Development in Malaya" treats the subject in detail and gives the results of trials and observations on this subject.

To sum up: there are distinct possibilities for the provision of the greater portion of the bulk fodder by grazing, with the addition of a light feed at night of fodder grass. Such a system requires more land per head than the soiling system, but it reduces considerably the calls on labour to cut and transport large quantities of fodder daily, with the sustained upkeep of soiling grass areas in labour and manures.

Turning now to cut fodders, results obtained at Serdang showed that when dressings of cattle manure were applied at the rate of 10 to 15 tons per acre per annum, yields of only 9 to 20 tons of cut fodder per annum were obtained. In the case of Guinea grass, for example, the following yields were recorded:—

Type of Land	Cut Fodder per annum tons	No. of Indian Cattle supported
Flat land of poor fertility ..	9	1.3
Sloping land of medium texture ..	12	1.8
Flat land of medium texture ..	16	2.5

At first sight these results appear to be very encouraging, but when it is stated that the production of manure per animal, including bedding, is about 6.5 tons per annum, we see that the above figures indicate that all the manure produced would have to be returned to the land to maintain the fertility of the areas and that none would be available for other purposes. It can, however, be inferred from the above data that a system of cattle farming based on cut fodders is quite feasible; that such a system would apparently be self-sustaining from the point of view of soil fertility; and that it would apparently permit a greater number of stock to be maintained per unit of land than would an exclusively pasture system. The soiling system can also be adapted to flat, hilly land or terraces, a decided advantage over the pasture system in a country which is predominantly mountainous or undulating.

With yields such as those obtained at Serdang the system would suffer from the disadvantage of requiring all the manure produced to be applied to the soiling grasses. There is evidence, however, that in other situations in Malaya higher yields may be expected, in which case some manure would be available for application to other crops. The part which cattle rearing is to play in the future of Malayan agriculture will depend largely on the productivity of fodder and grazing grasses under different manurial treatments, and much field experimentation will be required before

stocking capacity and manurial requirements are known for all the varying conditions found in Malaya.

A surplus manure-producing variant of the simple cut-fodder system described above could perhaps be developed in conjunction with the use of nightsoil. The bulk of the nightsoil in Malaya is at present wasted. This is due chiefly to two reasons: firstly, many people are strongly prejudiced against foodcrops which have been manured with human excrement; secondly, unless the application of nightsoil to such crops is very carefully controlled there is serious danger that it may cause outbreaks of certain diseases among consumers. This prejudice, and apparently the danger too, would be obviated by applying the nightsoil in fairly deep trenches between rows of grass in fodder-crop areas, permitting the cattle manure produced to be used for general crop production.

There would appear to be possibilities, too, of increasing the number of cattle and buffaloes kept in many padi districts. It was pointed out in a previous section that under present conditions the stock frequently go hungry when the padi crop is occupying the land, since the padi sawahs in the off-season constitute their chief grazing areas. It has been suggested that the ill-effects of this "hungry season" might be avoided by one or a combination of the following alternatives:—

- (i) The introduction of rotation into padi growing, by which a fraction of the area would be set aside each year and either planted with fodder crops or grazed. The area thus set aside would be rotated each season.
- (ii) The setting aside of a definite un-rotated portion of the padi area for fodder crop production, in conjunction, say, with cheap housing, so that the manure and bedding produced could be conserved and used to maintain the fertility of the fodder reserve. In one experiment of this nature carried out at a Padi Test Station in Malacca it was shown that with fodder grass planted on a strip of high land, in conjunction with average grazing, it was possible to maintain the stock in prime condition the whole year round and to obtain an excess of manure over that required for maintaining the fertility of the fodder areas. Unfortunately, there is little reason to hope that the same results can be obtained all over Malaya, though there can be no doubt that conditions generally are capable of considerable improvement.
- (iii) The conservation of fodder. The climate of Malaya varies to some extent in different parts of the country; it can, however, be accepted throughout as being typical of the wet tropics, having a high rainfall associated with consistent high atmospheric temperatures. The precipitation of rain is seasonal; two pronounced wet seasons occur with a short and a fairly long intervening dry season.

The climate permits of a continuous growth of vegetation throughout the year, but the rate of growth is faster during the wet than in the dry seasons. It follows, therefore, that if the level of production of roughage from an area during the dry seasons is sufficient for a certain number of cattle there must be an excess in the wet seasons.

Unless common land or other areas outside the holding are available to augment fodder supplies during the dry seasons, it would appear desirable to plant an acreage of land sufficient to provide an excess of fodder during the wet season; this could be ensiled for feeding during the dry weather. The alternative would be to make hay, but the drying of grass in the wet seasons would be a precarious process and for this reason the making of silage is advocated. The harvesting and stacking of padi straw for feed during the time the padi crop is occupying the sawahs deserves serious consideration. This would supplement the meagre grazing often available and enable sawah buffaloes and oxen to maintain their condition during this season of meagre supplies.

Balanced Rations.

The ideal to aim at in feeding all kinds of livestock is to provide them with "balanced rations." A balanced ration supplies all the necessary food constituents, namely proteins, fats, carbohydrates, fibre, mineral matter and vitamins, and is so adjusted or balanced that it will, by the time the appetite is satisfied, provide not only for the maintenance of the animal but also for the productive purposes for which it is kept, while avoiding excessive over-supply of any constituents which would be excreted as undigested waste. Limited excesses of proteins and carbohydrates may result in their conversion to fats, and storage as such in the body.

To compute a balanced ration for any particular kind of stock appropriate tables must first be consulted to discover their nutritive requirements and then consideration given to the analyses of the individual food-stuffs available. Then, considering other factors such as palatability, bulk and (very important) price, a ration is worked out and its effectiveness tested in practice by noting the reaction of the animals.

The above must not be taken to mean that all kinds of livestock require a complex ration that is made up from several different foodstuffs. For example, it has already been pointed out that buffaloes can be maintained in good condition on grass alone, given sufficient quantities, which means in this case that grass alone constitutes a more or less balanced ration for the animal in question. Generally speaking, it is only when an animal is working hard or producing young, or quantities of milk, or is growing fast that one need give much attention to the question of supplying "concentrates" as part of a scientifically balanced ration. The follow-

ing table of feeding standards (according to Kellner*) shows the nutritive requirements of different kinds of cattle.

Table I.
Daily Feeding Standards (per 1,000 lbs. live-weight).

Animal	Total Dry Matter	Digestible Matter			Crude Protein
		True Protein	Fat	Carbo-hydrate	
(a) At rest, (maintenance)	lbs. 15-21	lbs. .7	lbs. .1	lbs. 7.5-9.5	lbs. .8
(b) Performing moderate work	.. 22-28	1.4	.5	12.2	1.7
(c) Fattening animal	.. 24-32	1.6	.7	13-16	2.0
(d) Milking cows:—					
(i) Daily yield—10 lbs.	22-27	1.2	.3	10.0	1.4
(ii) " " —20 "	25-29	1.7	.5	12.2	2.1
(iii) " " —30 "	27-33	2.3	.6	13.8	2.8
(e) Growing calves:—					
150 lbs. live-weight	.. 23	3.4	2.0	13.0	3.7
300 " " "	.. 24	2.8	1.0	13.0	3.1
500 " " "	.. 26	2.3	.6	12.7	2.6
(f) Stud bull†	.. Requirements probably vary from (a) to (b) above, depending on condition, the frequency with which they are used for service, etc.				

Table II.
Standard Serdang Concentrate Mixtures (1941).

Constituents	Proportions by Weight					
	Calves	Dry (pregnant) cows	Milking Cows			Stud Bulls
			(i)	(ii)	(iii)	
Parboiled rice						
polishings ..	1	2	3	5	3	3
Wheat middlings	1	2	3	3	—	3
Broken rice ..	—	—	—	—	3	—
Coconut cake ..	—	1	1½	3	1½	2
Groundnut cake	—	—	—	—	½	—
Linseed cake ..	2	—	—	—	—	—

The Pre-war Serdang Feeding System.

(a) *Calves:—*

The method of feeding calves varies according to whether or not the mother will let down her milk when the calf is not present. Many Indian cows cannot be milked, and some dry up very quickly, when the calf is

* "The Scientific Feeding of Animals."

† Curiously enough, Kellner does not give standards for breeding bulls. A breeding sire must be well-exercised and maintained in "hard" condition.

taken away from them. With such animals, at Serdang, the calf was allowed to suckle at each milking, being allowed to take about 8 pints of milk a day in this manner. The allowance of milk was reduced to 6 pints at the 4th week and $\frac{1}{2}$ lb. concentrate mixture was provided. The latter was increased to $1\frac{1}{2}$ lbs. by the 8th week and kept at this figure until the calves were about a year old, the allowance of milk being cut down gradually so as not to interfere with growth. In some cases the calf was allowed to be present at milking throughout the lactation period. When the mother did not object to the absence of her calf, the calf was treated as above except that it was taught from birth to drink its milk requirements from a bucket. This milk, of course, was supplied warm.

From about the 4th week calves were allowed to graze *ad lib.* in paddocks (i.e. for about 10 hours a day) and were fed quantities of cut Guinea grass fodder which increased from a nibble only at 4 weeks up to about 20 lbs. a day at 2 years of age, by which time they were also receiving about 3 lbs. of concentrate mixture daily. The general rule was to feed as much fodder as they would eat.

(b) *Dry and Pregnant Cows:—*

In the case of Indian and cross-bred animals, grazing was *ad lib.*, and from 40 to 60 lbs. fodder per day were provided. Cows which did not maintain condition were in addition fed extra rations of from 1 to 5 lbs. daily of the appropriate concentrate mixture. Pure-bred cattle would almost invariably need the extra concentrates.

(c) *Milking Cows:—*

An 800 lb. cow giving about a gallon of milk a day would be grazed *ad lib.* and given from 40 to 60 lbs. of cut fodder and $3\frac{1}{2}$ lbs. of concentrate mixture (i) (or $3\frac{1}{2}$ lbs. of (iii)) a day. A similar animal yielding up to 2 gallons daily would be treated as above but given about 7 lbs. of mixture (ii) daily. (*Vide* Table II).

(d) *Stud Bulls:—*

When space permitted stud bulls were grazed daily and given about 60 lbs. cut fodder daily. If they lost condition, or were frequently in service, they received from 1 to 7 lbs. of the appropriate concentrate mixture daily in addition.

The Feeding Routine at Serdang.

EXPLANATION OF TERMS.

$\frac{1}{2}, \frac{1}{2}, 1$ = the fraction of the whole day's supply of the food mentioned.

C.M. = the appropriate concentrate mixture.

C.F. = cut fodder.

TYPE OF ANIMAL.

Time	Calves		Dry Cows	Milking Cows	Stud Bulls
	Unweaned	Weaned			
1 a.m.	—	—	—	—	—
2	Washed	—	—	—	—
3	—	Washed	—	Washed	—
4	Suckled or bucket fed	$\frac{1}{2}$ C.M.	—	Milked	—
5	$\frac{1}{2}$ C.M.	—	—	$\frac{1}{2}$ C.M.	—
6	—	—	—	—	$\frac{1}{2}$ C.M. if required
7	$\frac{1}{2}$ C.F.	—	—	—	—
8	Grazed	Grazed	—	—	—
9	—	—	—	Grazed	—
10	$\frac{1}{2}$ C.F.	—	—	—	—
11	—	—	—	—	—
Noon	—	—	Grazed	—	Grazed of possible
1 p.m.	Washed	$\frac{1}{2}$ C.M.	—	Washed	—
2	Suckled or bucket fed	—	—	Milked	—
3	—	—	1 C.M. if required	$\frac{1}{2}$ C.M.	$\frac{1}{2}$ C.M. if required
4	$\frac{1}{2}$ C.M.	Grazed	—	—	—
5	Grazed	—	—	Grazed	—
6	$\frac{1}{2}$ C.F.	1 C.F.	1 C.F.	1 C.F.	1 C.F.
7	—	—	—	—	—
8	—	—	—	—	—
9	—	—	—	—	—
10	—	—	—	—	—
11	—	—	—	—	—
Midnight	—	—	—	—	—

Notes.—(a) The concentrate mixture and cut fodder were almost invariably fed in the byre or other housing; very rarely in the field.

(b) Dry cows and stud bulls were washed as required.

Some Practical Points on Feeding.

Anyone concerned with livestock should be acquainted with the following general rules:—

- Fodder crops, e.g. Guinea grass, become more fibrous, and hence less digestible and nourishing, as the interval between successive cuttings is increased. Such fodders therefore should always be cut and fed when reasonably young and succulent, e.g. at intervals of 1 month in the case of Guinea grass.
- Gentle exercise aids digestion, very hard work diminishes it. Therefore it is necessary to ensure that stud animals are adequately exercised and that hard-working draught animals receive a fair proportion of readily-digestible foods.
- Cooking, boiling, or soaking of livestock rations is generally to be avoided, unless specific reasons exist for the practice, e.g. the destruction or elimination of toxic matter from a foodstuff by

boiling (discarding the water used), the softening of hard concentrates, (e.g. broken rice and oil cakes) by soaking, and so on.

- (d) Nitrogenous concentrates, e.g. the oil cakes, suffer no loss in nutritive value when fed with fodders, nor do they impair the digestibility of fodders. In fact, it often pays to have a mixture of the available foods, as in an effective mixture the value of one constituent frequently enhances that of another. Foods rich in carbohydrates, e.g. sweet potato and tapioca, on the other hand, when fed to excess lower the digestibility of fodders and hence should be used with moderation.
- (e) Provide plenty of clean drinking water, as much as the animal will drink. It is not unusual for a cow in heavy production to require up to 20 gallons of water a day, which emphasizes the necessity for a copious water supply.

In addition to the above, the following general rules, which represent current temperate climate practice, may be helpful:—

- (a) Feed at all times all the roughage, e.g. cut fodders, that horned stock will eat.
- (b) To ensure maximum production, feed 1 lb. of concentrates per day for each 3 to 4 lbs. of milk produced.
- (c) Feel free to increase the feed as long as the animal is not gaining weight.
- (d) Ensure that the animals receive an adequate supply of minerals.

With reference to (c) above, it must be remembered that livestock, unlike poultry, are or can be fed individually. Animals vary not only as between breed and breed, but within the same breed and even within the same strain. The quantity of food supplied should therefore be adjusted from time to time in accordance with the condition and productive level of the individual animal; individual study and observation are therefore required.

With regard to minerals, it has been found at Serdang that a mixture made up of equal parts of steamed bone meal, finely ground limestone and common salt suffices. Animals receiving no concentrates receive salt only *ad lib.* in the form of a salt lick. In the case of animals receiving concentrates, 2 per cent. of the above mixture is mixed with the concentrates provided, calves, however, receiving 1 per cent.

Before concluding consideration of the question of livestock improvement through better nutrition and before turning to that of improvement through breeding, it is essential that the following two points be emphasized:—

- (i) Native breeds of livestock in some tropical countries have been shown to be susceptible of considerable improvement by better feeding alone. Discussing Indian milch cows, for example, one authority has said, “a careful analysis of the yields of the

purchased cows shows that such animals give an average increase of 60 per cent. in their milk yield as a result of better feeding and management alone." It is probably safe to say that tropical livestock generally are in the above position, not excepting those in Malaya.

- (ii) Improved animals, e.g. bigger or more productive animals, require more food than unimproved stock. Given a more or less constant food supply, therefore, it is apparent that improved breeding should only be practised when it is realized that it may entail a reduction in the livestock population concerned, i.e. where the livestock owners have been persuaded that one superior animal is a better economic proposition than two inferior ones. It follows also that where it is desired not only to maintain or increase the existing livestock population but also to improve its quality then the problem of increasing the supplies of livestock food must be investigated and solved in advance; all of which suggests that as a general rule the problem of better feeding should take priority in time over that of improvement by breeding.

The preceding notes have sketched the outlines of the local feeding problems; they have shown some of the methods by which the major problem, that of producing more grass, may be solved and how dairy cattle should be fed under food conditions of management. Nothing has been said about Indian-owned dairy cattle or milch buffaloes, but in general their requirements are similar to those of the stock reared pre-war at Serdang, and the nearer the feeding practices adopted can be made to resemble those at Serdang, the nearer will such animals approach to receiving an adequate, balanced ration.

The Improvement of Horned Stock by Breeding.

The preceding articles have, it is hoped, conveyed a general picture of livestock and livestock problems in this country, and in particular have dealt in some detail with the present position as regards buffaloes, cattle and dairying. They have shown that, judged by ordinary criteria, there is considerable room for improvement, not only in respect of feeding and management generally but also in respect of breeding. The more important aspects of feeding have been covered in the preceding portion of this section; various improvements in respect of management have been suggested, and it now remains to consider in some detail, the problem of breeding, leaving questions of improvement from the point of view of disease to be dealt with in a later article.

The Degree of Improvement Required.

One of the biggest questions facing the tropical livestock industry is that of deciding, as an immediate objective, how far it is desirable to improve the present livestock populations by breeding. Improved stock need improved feeding and as a rule more care than ordinary unimproved

stock. Improvement by breeding must therefore at most go hand in hand with improvement in the general environment of the livestock concerned and always there is the economic aspect to be considered—"does this or that measure of improvement pay?" A very heavy responsibility therefore rests on those whose duty it is to decide how far one should aim at improving local livestock in a given period of time, and as a general rule it is only when scientific research has indicated the answer that definite recommendations can be given.

It is obvious that for many years to come at least there can be no question of trying to reach under local conditions the high level of breeding and productivity, which characterizes livestock in most temperate countries to-day. It must be remembered that many, if not all, of the contemporary Western breeds of *Bos taurus* exhibit a high degree of specialization, which has been developed by breeders to satisfy specialized market requirements, while certain tropical breeds, e.g. the Kedah-Siamese stock, are bred purely for beef and draught purposes. The tendency in the western States of Malaya is to develop a breed of animals that will produce more milk than that required by the calf, while possessing a conformation which enables surplus males to be useful as draught animals.

While we have seen that from one point of view livestock-keeping here can be regarded chiefly as a manure-producing adjunct of agriculture (numbers versus quality), it is equally obvious from the opposite point of view that animals kept for the production of work, milk and meat should if possible be improved, on the generally accepted principle that one good animal is better than two poor ones (quality versus numbers). In the end, the livestock owner himself must decide, after considering factors such as his market, his own circumstances, and the best advice available, which course of action is best suited to his needs, and we can now consider some of the general knowledge and particular facts with which he should be acquainted if he wishes to improve his herds by breeding.

Systems of Breeding.

It may surprise the agricultural student, familiar with the great improvements wrought by genetics in the world of economic plants, to learn that up to the present this science has played very little part in the improvement of our domesticated animals. Genetics is a new science and the problems of animal improvement are more complex than in the case of plants. Animal breeders to-day, like those many centuries ago, rely chiefly on the law of heredity which states that, "Like begets like," i.e. that the characteristics of the parent tend to appear in the offspring. This law, together with a knowledge of how to select superior individuals for mating together, is the basis of all systems of controlled breeding.

NATURAL BREEDING.

In this type of breeding no conscious control is exercised by man. Animals are allowed to mate as and when they will, though under natural

conditions as a rule it is the stronger and more vigorous males which most frequently enjoy the privilege. There is thus a measure of "natural selection" as opposed to human selection. Natural breeding, as we have seen, is not at all uncommon in the case of domesticated animals in the tropics. Two great drawbacks are immediately apparent. Firstly, domesticated animals as a rule do not have to contend with "nature in the raw"; their owners make some attempt to feed and look after them and as a consequence they may survive to breed, whereas the harsher conditions of a purely natural environment would otherwise have eliminated them before maturity. Secondly, when the native livestock owner sells his animals he is frequently tempted, when offered ready money, to sell the best of his stock, leaving him with inferior specimens to become the parents of future generations. Under domesticated conditions, therefore, we see that natural breeding, based on inferior, unselected parents, can result only in loss of vigour, which is maintained under purely natural conditions, and loss of productive capacity, which, together with vigour, is maintained and improved under a scientific system of breeding. A large measure of the deterioration found throughout the tropics to-day is undoubtedly due, directly or indirectly, to such uncontrolled mating.

SELECTIVE BREEDING.

Selective breeding, as its name implies, is controlled breeding, in which only certain selected animals are allowed to mate. There are five important systems of selective breeding:—

- (a) In-Breeding,
- (b) Line-Breeding,
- (c) Out-Breeding,
- (d) Cross-Breeding,
- (e) Upgrading.

(a) *In-Breeding.*

In-breeding is the practice of mating together animals which are closely related, e.g. brother and sister, or father and daughter and is normally carried on to "fix" a type. Close relations share a similar genetical inheritance and by mating them together it is possible to confer on the progeny pure factors for desired characteristics. Such pure factors, in the absence of mutation, will thereafter breed "true to type," and thus it is possible to obtain definite "breeds" of animals (and plants) which faithfully reproduce their characteristic features for generation after generation. It was by in-breeding that all the contemporary recognized breeds of livestock were originated.

There is a serious danger inherent in in-breeding, namely that it is just as easy to "fix" undesirable characters as the opposite. Close relations tend to have the same faults, as well as virtues, and in-breeding tends to concentrate these in the progeny. It has been suggested, for instance, that in pigs the accumulation of lethal or detrimental genetical

factors by in-breeding may be the cause of incapacity to produce normal litters of progeny. In-breeding should be practised, therefore, only when the very greatest care has been taken to ascertain that the relatives selected for mating together are outstanding individuals in every desirable way, and particularly in respect of health, size and vigour, and further where the breeder is prepared ruthlessly to discard the weaker progeny. The common fallacy that in-breeding must lead to loss of vigour is due to the fact that there has in the past been a tendency among breeders to base their selections too largely on one character only (most frequently that of high productivity), forgetting the cardinal fact that only those animals which have also inherited a strong constitution can under ordinary conditions "stand up" to the strain of continued high production.

So far as is known at present, therefore, and providing that the greatest care is taken in selecting the breeding stock, and discarding weak progeny, in-breeding is a safe and quick method of fixing a type and thereafter of maintaining it. The high degree of knowledge and judgment required, however, and the scarcity of really first class stock make this system the special province of the expert and of the highly skilled breeder of pedigreed stock. Moreover, it is, especially in the early stages and in view of the ruthless discarding, a highly expensive undertaking, and unless carried on under expert supervision it may lead to serious financial and technical troubles and obviously cannot be recommended to the ordinary native livestock owner.

(b) *Line-Breeding.*

This system consists in the mating of animals of the same family, i.e. those which are derived from the same line of descent, while avoiding too close a relationship. Compared with in-breeding, it is easier by this system to maintain constitutional vigour while fixing or maintaining a type, but it takes longer to fix a type. There would seem to be no reason why this system should not be recommended to any intelligent owner or manager of pure-bred stock in this country.

(c) *Out-Breeding.*

This system of breeding consists in the mating together of animals belonging to different families of the same breed. It is commonly practised when a breeder sees in the stock being produced by some other breeder characters which he would like to combine with those of his own stock, or when, usually as a result of in-breeding, his own stock is beginning to exhibit loss of constitutional vigour, manifested most commonly perhaps by poor fertility or actual sterility. This method of "obtaining new blood" is of considerable value because, while it enables the breeder to retain the main characters of his herd, i.e. to keep his stock "pure," it offers him a much wider field of selection than he would find in his own herd, and provides, in addition, a simple way of renewing the vigour (a form of "hybrid-vigour") of his stock. Out-breeding thus is a popular practice

and can be generally commended in the case of pure-bred stock in the tropics and elsewhere.

(d) *Cross-Breeding.*

This system of breeding consists in the mating together of parents each of which belongs to a different pure breed, or may be extended to the mating of animals of different species.

(e) *Upgrading.*

Consists generally in the mating together of animals of the same breed or species i.e. a pure-bred parent, almost invariably the male parent, and female parent(s) of mixed or unknown ancestry. This method may be extended to the mating of cross-bred females to pure-bred males with a view to improving the successive generations of progeny.

Both the cross-breeding and upgrading systems, perhaps more than any other, depend for their success on two characteristics with which the stockman should be familiar, namely, prepotency and vigour imparted to offspring by the mating of animals of distant families. Cross-bred progeny are specially favoured in this respect, being endowed with what is usually termed "hybrid vigour."

An animal is said to be prepotent when it exerts a strong fertilising influence or possesses the power of transmitting its own characters to its progeny in a high degree. The pedigreed or pure-bred male, having a known line of ancestors, is more prepotent for desirable characters than the mongrel male of mixed ancestry. One male can mate with a number of females and thus lead to the simultaneous improvement of many progeny; it is therefore more economical to use pure-bred sires for the upgrading of livestock.

Crossing followed up by upgrading is carried on to a considerable extent in various countries for producing size, good quality meat, early maturity, and so on, and as a general rule the first generation of progeny exhibit a noteworthy increase in constitutional vigour, productivity and the like. Livestock generally and also plants tend to exhibit this phenomenon of "hybrid vigour." Successive upgrading, using in each case a fresh pure-bred sire on the dams of mixed blood usually results after a few generations in a type of animal that is to all intents and purposes like its pure-bred male progenitors, but less is known as to the result obtained when cross-bred stock are mated together, e.g. a half-bred sire on a half-bred dam. It can be said with certainty that as a rule the progeny of such a cross would be lacking in uniformity, and while some authorities claim that by a process of crossbreeding and selection it would be possible to obtain a distinct breed of tropical cattle, this has not yet been done, at least on a large enough scale for the practice to be recommended with confidence. The whole question of upgrading under tropical conditions is somewhat complex and uncertain, and some of the basic issues are considered in the following section.

The Malayan Problem.

In Malaya, we have five kinds of horned stock to consider:

- | | | |
|-------------------------------|---|--|
| (a) Pure-bred European cattle | — | kept for milk production. |
| (b) Thai-Kedah cattle | — | kept for draught purposes and beef production. |
| (c) Indian cattle | — | kept for milk, beef and draught purposes. |
| (d) Indian buffaloes | — | -do- |
| (e) Malay buffaloes | — | kept for draught, beef and milk purposes. |

With the preceding section on "Systems of Breeding" in mind we can see that in general the would-be breeder of any of the above kinds of cattle and buffaloes, regardless of the purpose for which his particular animals are kept, must proceed along the following general lines.

Stage 1. He must first form a clear mental picture of the type of animal he aims to produce, i.e. his particular ideal.

Stage 2. He must then select as parents those animals which conform most closely with the ideal and mate them, continuing the process for generation after generation.

In deciding his ideal he must have a good general knowledge of the kind of animal with which he is working; he should know what a good average animal of that kind can do in the way of work or production, and what the best can do. This will prevent him from setting his standards impossibly high. Then he must be a good practical judge of cattle, acquainted with the "points" of his type, i.e. those characteristics which experience has shown that superior individuals should possess. Cattle judging is partly an art, for some points cannot be measured scientifically but must be determined by eye and hand working in conjunction with instinct and experience, and partly a science. The examination of pedigrees, or of milk yield records, for example, represent some of the scientific aspects of cattle-judging.

Having decided his ideal the breeder must then select his breeding stock, animals which resemble as closely as possible the ideal he has in mind. Since it is unlikely that he will find animals in his own herd that reach the ideal he must be able to weigh the good points and the bad, setting one off against the other and deciding, on average, which are his best animals. He may decide that "out-breeding" is advisable, in which case he will have to inspect and purchase stock from other breeders who have animals of the type required. In the case of pure-bred stock he would be assisted in his choice by inspection of pedigree and production records normally kept by the breeders, but in the case of indigenous or Indian cattle and buffaloes such records are seldom available, unless he could arrange to purchase from an official institution, and his choice would thus be more difficult. In all his selections he would remember that "the bull is half

the herd," paying particular attention to his breeding males, and in males and females, to constitutional vigour.

The progeny of his first selection would in due course be reviewed and the best females chosen as breeding dams. He would have to decide whether to in-breed, line-breed or out-breed them, and obtain his males accordingly. It is probably safe to say that as a general rule the ordinary native stockman would be well advised to leave in-breeding severely alone, to use line-breeding sparingly and in general confine himself to out-breeding and up-grading his herd, though much depends on the knowledge and skill of the individual. When using his own sires he knows quite a lot about them, which might not be the case with purchased stock. Such a programme, continued for generation after generation, would mean *inter alia* that steps would have to be taken to prevent unselected males from breeding, either by segregation, disposal, or castration. It would entail some form of system, particularly in the case of dairy stock, for recording the success or failure of each particular individual. A breeding programme covers decades, and memory alone is insufficient. The true test of any mating is the quality of progeny produced and the performance of each bull on each cow from this aspect should be recorded. Good matings could then be repeated, unsatisfactory ones avoided.

Such then is the general method by which the various kinds of stock in this country could be improved by breeding. The next section deals specifically with the problem of improving the local Indian dairy stock. The crossing of *B. taurus* and *B. indica*, incidentally, represents the extreme limit cross, i.e. it is the crossing of two distinct species of animals. While the progeny is not sterile as is the case with the mule, they carry heterogeneous characters which are liable to recur in subsequent generations.

The Improvement of Indian (Zebu) Dairy Cattle.

Humped Zebu cattle are widely distributed throughout the tropics. In general, they are nondescript in appearance but in countries like India well-defined types exist and, as is the practice in Europe, they are classed as breeds. The Indian cattle in Malaya are in the main descended from imported stock whose origin is no longer known and from the stand-point of breeding can be regarded only as a more or less heterogeneous mixture of several Indian types. Mongrel stock of this nature can generally be improved either by selection within the breed (if such cattle can be called a breed) or by crossing with pure-bred stock followed by upgrading; the remainder of this section will point out the pros and cons of each method.

General Considerations.

First let us refresh our memories with respect to the chief characteristics of Indian (*Bos indica* Zebu) and European (*Bos taurus*) animals.

The Zebu represents a type of animal which has been evolved in conformity with a tropical environment. It has accordingly developed certain valuable constitutional characteristics, the more important of which, according to one authority, are as follows.

- (a) Compared with *taurus* the Zebu has a better digestion for, and makes better use of, roughage; consequently, it is able to extract more nutriment from coarse food.
- (b) It possesses a better heat-regulating mechanism, having a greater area of skin and ability to perspire, short hair and a pigmented skin.
- (c) It is both resistant to, and tolerant of, external parasites, for, in addition to possessing a tough skin, it is thought that these animals give off an odour repellant to insects.
- (d) It possesses considerable powers of resistance in particular to tropical diseases and exhibits a resistance or tolerance towards internal parasites, e.g. worms.

As opposed to the above, while superior individuals certainly exist, quality and production are generally on a very low level.

European cattle, on the other hand, bred for generations in a temperate climate and to definite productive standards, require relatively large volumes of reasonably good quality food if they are to express fully their genetical inheritance. They cannot be expected to withstand a tropical environment as well as the Zebu and are naturally less resistant to tropical parasites and diseases of livestock. The position of pure-breds in the tropics will be discussed later; here we need say only that given adequate nutrition and care they can do reasonably well in many tropical countries.

There are two distinct schools of thought with regard to the question of how best to improve Zebu cattle in Malaya by breeding. The first claims that in the long run the best results will be obtained by selection within the breed, with or without the importation of superior Zebu stud animals. The other school claims that it is obviously desirable to take immediate advantage of the inherited high-productivity of the European pure-bred and that the best course accordingly is to try to combine the desirable characteristics of both breeds by crossing, followed by upgrading. A considerable amount of evidence has been collected in a number of tropical countries, and there is obviously something to be said for both points of view. It will be instructive if we survey this evidence, for while breeding research in Malaya has up to the present been on too limited a scale to contribute much to it, it should be safe to assume that the experience of other tropical countries in this connexion may be applied more or less directly to local conditions. Any improvement made will tend to be in the direction of producing a better general purpose (milk, meat, draught) animal, for, as pointed out earlier, the single purpose animal is not at present required in the tropics.

Selection Within the Breed.

Little is known about the possibility of improving Zebu cattle from the meat and draught aspects by modern methods of breeding, for very little research on this problem has been recorded. In a number of countries, however, the local working animals have been improved to a considerable extent by crossing with imported superior strains from India, e.g. in the Philippines, Nellore (S. Indian) sires are considered to impart hardiness, good grazing qualities and resistance to disease, and there can be little doubt that in Malaya, where the Zebu cattle are of Indian origin, intelligent selection and the occasional importation of good strains from India would result in improved draught and meat animals.

Improvement in milk yield, on the other hand, is easier to measure scientifically (e.g. by dairy recording) and Indian experience shows that Zebu cattle can be very substantially improved in this respect by careful selection and breeding. The improvements recorded there are not confined to one breed or to one district, but it will suffice as an example to state that at one agricultural college dairy farm, working with Montgomery cattle, the average annual yield of milk was increased from 2,000 lbs. in 1913 to 7,000 lbs. in 1938. The champion cow yielded over 10,000 lbs. of milk in each of three successive lactations, and the college is now able to lay down a minimum of 5,000 lbs. for inclusion in the herd. Such increases, obtained in a relatively short space of time, are startling, even when it is mentioned that the world's champion cow yielded over 40,000 lbs. of milk in her best year, and they give considerable point to the argument of those who oppose cross-breeding in favour of selection within the breed.

Upgrading.

There appears to be no record of any attempt to improve indigenous Zebu stock as working animals by upgrading and, due doubtless to the general desire for a multi-purpose animal, not a great deal of work has been done in tropical countries to produce specialized beef cattle from indigenous stock by this means. The improvement of beef stock by crossing in many sub-tropical areas, however, has been a distinct success, as also in those areas of certain tropical countries which, by virtue, as a rule, of their high altitude and suitability for ranching methods, are able to make an economic success of beef production pure and simple.

Coming now to the question of dairy animals we enter the sphere where the breeding controversy is most acute. The very existence of controversy indicates that our knowledge is incomplete and that one cannot be too dogmatic. One must therefore survey the evidence available, study local conditions and decide whether to resort to cross-breeding followed by upgrading.

It may be accepted as a *sine qua non* that cross-breeding is a practical proposition only in those countries where the European pure-bred has demonstrated its ability to thrive and reproduce. No serious cross-breeding

policy can be envisaged which relies on the importation of the large number of sires required; economic factors necessitate that these should be locally bred. In this connexion, the technique of artificial insemination, to be discussed later, may become increasingly important, but we must deal with things as they are now.

The European pure-bred has succeeded in establishing itself in some tropical and sub-tropical countries, but not in others. Given adequate feeding and care, the breed selected and incidence of disease appear to be very important factors in this respect. The Friesian, Red Poll and Channel Island breeds have been more successful than the Ayreshire or Shorthorn. In some countries, e.g. South Nigeria, disease has so far prevented the successful establishment of pure-bred herds and one is safe in saying that the same is true of East and West Africa generally. In India, Rhodesia, the West Indies, Fiji and Hawaii, on the other hand, the pure-bred has succeeded in establishing itself, though the extent to which the continued importation of fresh blood is necessary in these countries is not known.

Pure-breeds tend to degenerate in the tropics unless their vigour is renewed from time to time, though the extent to which they do so or precisely why they do so, are subjects of controversy. One can conclude, however, that given "experiment station" conditions of management, or their equivalent, it is possible to maintain pure-bred *taurus* herds in many tropical countries, and this appears to be true on the highlands of Malaya. Experience on the plains in this country, while not based on any large-scale trials or observations, suggests that *taurus* herds can be maintained here only by the frequent importation of breeding stock of both sexes; as an example, Singapore-bred and reared heifers are undersized and often sterile.

Cross-breeding is out of favour in India, tropical Africa generally, and the Philippines; it is popular in the West Indies, Rhodesia, Fiji and Hawaii. It is unfortunate that Indian experience should have been based largely on the Ayrshire, since this breed is now generally accepted to be unsuitable for tropical conditions. It was, at least until recently, favoured in Hongkong. A wider range of trials with more suitable breeds might have told another story. In Fiji and Hawaii, on the other hand, the absence of ticks and livestock virus diseases has undoubtedly contributed largely to the popularity of upgrading in those islands. With regard to Malaya, cross-breeding has been on a very restricted scale and thus its popularity cannot be assessed with any degree of accuracy.

One of the big questions in cross-breeding is: "Where is it going to end?", i.e. how far is the practice of successive crossing to be carried, and on the evidence available it is not an easy matter to decide the exact proportions of European and Zebu blood that will give productivity without losing constitutional vigour. Not forgetting that, to quote one authority, "the degree of improvement must be dictated by the plane of nutrition," one must also consider the generally widespread evidence that while the

first-cross progeny as a rule exhibit considerable improvement in size and productivity, higher grades tend to break down constitutionally and, to quote again, "are disappointing in their rates of growth, body development and milk yields." One authority holds that such constitutional failure is due to factors which are at present unknown and that a serious developmental problem thus exists in subsequent upgrading. Experience in this connexion varies. In Trinidad, Friesian Zebu matings have been carried to the 7/8ths stage without apparent loss of constitution. In Jamaica, it is claimed that the ideal is from the $\frac{3}{4}$ to 31/32nd stage, i.e. from the 2nd to the 5th cross. In general, therefore, one can only say that the grade which does best must be determined by experience under local conditions. Assuming this to be settled, selected individuals of this grade should then be mated together, so that by in-breeding and vigorous selection a new breed might be established, one capable of economic productivity in the local environment.

Considering the above standpoint, one is left with the conclusion that the exponents of cross-breeding have not a cast-iron case in their favour, that insufficient is known to permit crossing and subsequent upgrading to be recommended, and that the Indian stockman is at present definitely advised to concentrate on improvement by selection within the breed. This is not to say that limited possibilities do not exist in Malaya for the enterprising person, for there is possibly much to be said for a first-cross dairy herd, based on a system in which a pure-bred sire and Indian cows constitute the breeding stock, and in which the calves of the second cross (cows must calve to produce milk) are disposed of as beef animals. Even this system might be a failure and knowledge must be obtained by experimentation. One possible reason for failing would be the difficulty of buying sufficient Indian cows to maintain the herds up to the requisite number. Again, we do not at present know sufficient about the behaviour of stock in the cooler areas of Malaya, e.g. Cameron Highlands, to assess the possibilities of establishing upgraded herds in the hills of this country. There would at least seem to be a wide field for research in these problems and until they have been investigated it will be difficult to make recommendations. In the case of cattle, breeding research is a long-term project and all authorities are agreed that continuity both of staff and policy are necessary if the best results are to be obtained.

Artificial Insemination.

We will conclude our brief survey of livestock breeding with a short consideration of artificial insemination. This might be defined as "breeding without the direct intervention of the male" and in practice is carried out by obtaining seminal fluid from a male, storing it under suitable conditions, and introducing it artificially into the vaginas of receptive females—thus impregnating them. Its advantages are immediately obvious. It is a well-known fact that at each ordinary union a vast excess of sperm cells is

produced, all but one of which in normal cases are wasted. Coupled with rapid air transport, the technique of artificial insemination allows the influence of an outstanding sire to be spread over very wide areas. One is almost tempted to say "over the globe," though that stage has not yet been reached. The technique has, however, in the case of many animals passed from the purely experimental to the practical stage. Some difficulties arise in connexion with the storage of the seminal fluid until it is required, since the sperms must not be allowed to die, but the technique is steadily being improved. As further progress is made one can envisage a cessation of the practice of importing stud males "on the hoof"; what we require of them will come "in the bottle." There would thus seem to be no reason why, for instance, in the reasonably near future, we should not be able to import sperms of the very best bulls in India. Although it is outside the specific title of this article, this contention would also apply to selected boars and buck goats. Considering all kinds of stock and the world as a whole we may by application of this technique be at the beginning of an era of unparalleled progress in livestock breeding.

MECHANISATION

Quarterly Progress Report, April to June, 1948.

Compiled by the Chief Field Officer.

Recent Importations.

(a) *Combine Harvester.*

This machine arrived in April and, after being assembled was despatched for trial to Chenderong Balai, Sungei Manik, Perak. In order to adapt it for use on the soft peat which exists on this site, considerable time and trouble were expended by the agents on designing a skid which would take the weight of the machine in the event of the wheels sinking. Unfortunately, while these preparations were being made, a heavy storm laid the only crop of padi which was still awaiting harvest, and a full trial could not be carried out. The machine, however, was given a trial run over the land with promising results, but it is probable that modifications to the skid will have to be designed.

(b) *Fordson Rotary Hoe Attachment.*

This attachment, which is driven from the side power take-off of a Fordson Major, has been under trial at Serdang. It was found to do a very efficient job of cultivation on land which had previously been dis-ploughed, and reduced the soil to a fine tilth. In heavy sheet lalang, however, the first run in the lalang eradication experiment was somewhat disappointing, as the blades could not thoroughly cut up the heavy blanket of grass even though the clutch was tightened up to the fullest extent. Two reports have been received from estates using this machine, indicating that more satisfactory results have been obtained and further trials are being undertaken.

(c) *TD.6 International Crawler Tractor.*

A trial with the 29 h.p. TD.6 International Crawler Tractor was undertaken at Serdang shortly after its arrival in April. The trial was made with a wide double-furrowed 16 ins. bottom McCormick-Deering plough. The time taken to plough 1 acre was 2 hrs. 15 mins., and fuel consumption (Diesel oil) was 2.14 gallons. The running costs worked out at \$2.50 per acre, which is approximately half the costs when a D.4 is used with the same implement. The average furrow depth was 9 ins. The tractor has since been sent to Chenderong Balai where it is doing satisfactory work under those conditions with certain modifications to the shoes.

(d) *Clifford Rotary Cultivator.*

Trials with this implement indicate that it is not likely to be as satisfactory as the "Gem" Rotary Hoe. Although it is only 4 h.p. and

works on power kerosene, the fuel consumption is very high and works out at a higher cost per acre than the latter machine. It could cultivate to a depth of only 4 to 5 ins. and covered .66 acre in a normal working day. Half a gallon of T.V.O. (power kerosene) was used per hour.

(e) *Grass Cutters.*

A number of different grass cutters have been under observation during recent months. Of these the Lloyds Autosickle has been found satisfactory for rough work on oil palm plantations. When used to cut vegetation between the rows the costs worked out at from 38 cents per acre of oil palm in easy conditions up to 68 cents per acre where the growth consisted of young *Melastoma*, *Eupatorium* and other tough species. A certain amount of trouble has, however, been experienced through the wearing out of certain parts. The Allen Autoscythe has been in regular use in the Public Gardens, Kuala Lumpur, and is doing very efficient work in moderately thick lalang. This implement has what promises to be a very useful spray attachment, which has been used against lalang and would also probably save labour if employed in anti-malarial work. With sodium arsenite one of the spray joints was found to corrode very rapidly, and this point is being taken up with the makers.

(f) *Hoe-Mate.*

The cutter-bar attachment to this machine is not quite so satisfactory as the two already mentioned, but is capable of doing fair work under comparatively light conditions.

(g) *Barford "Atom" Mechanical Gardener.*

The cutter-bar attachment to this very small machine is of use in close work only. This implement also has a hedge clipping attachment, which performs satisfactory work, but its length of life is a doubtful factor.

Modifications.

The work of modification during the quarter was largely directed to the problem of reducing the bearing pressure on the wheels and tracks of tractors to enable them to perform operations in wet padi fields.

(a) *D.4.*

A broad gauge D.4 has been successfully adapted to work on the soft peat on the Federal Padi Station at Chenderong Balai in the Sungei Manik District of Perak; 34 ins. lengths of 6 ins. x 6 ins. angle iron have been fitted to alternate track shoes. The machine is, however, still too heavy at the back, and experiments in lengthening the tracks are in progress.

(b) *Fordson Major.*

Extension rims with 5 ins. strakes, though of value in the first cultivation while the land is firm, are found to be unsuccessful on soft land.

Open work "paddle wheels" were therefore designed for both front and back wheels, and show great promise. The dimensions of the rear paddles are 40 ins. diameter and 30 ins. wide, and the front wheels have a width of 18 ins. The paddles are $3\frac{1}{2}$ ins. and were cut from angle iron. The machine is remarkably manoeuvrable, and the wheels alone perform useful cultural work.

(c) *Howard Rotary Hoe.*

Many modifications of this machine have been tried. The latest and most successful so far is a form of paddle wheel which clears the main frame, but this makes it very hard on the turn. It is rather doubtful whether this machine will stand up to the rough conditions for a sufficiently long time to pay off its capital cost economically.

Experiments.

Experiments to determine the effect of both time and depth of cultivation on the subsequent crop have been laid down at Padi Test Stations at Bukit Merah, Province Wellesley, and Pulau Gadong, Malacca, and in various places in Kelantan.

Trials with different drill spacings and rates are being undertaken with wet padi at Chenderong Balai, Perak, and with dry padi at Melor Dry Padi Station, Kelantan.

Selected Articles.

TAKING STOCK OF FARM POWER AND MACHINERY RESEARCH*

A Symposium.

The requisites for quality research are good men, fundamental problems, sound thinking, and carefully controlled experiments. These requisites indicate that research is largely a thought process. Man by his thinking must first define the fundamental problem; then by the same power provide the solution. Experiment serves to check the logic developed. Considering these facts, plus the great scope of the agricultural industry, research of broad implications demands co-ordinated functioning of a group or groups of minds. This conclusion applies especially in the extensive field of agricultural engineering; there are few, if any, branches of agricultural science in which co-operation and co-ordination of effort are so imperative.

Therefore, it seems logical that the most effective co-operative effort of the state, federal, and industry research agencies can be gained by co-ordinated functioning of the minds of technical representatives in order that the technical aspects of each problem may have competent attention. Such co-operation cannot become fully effective, however, without definite planning for an action agency. Some progress in co-operative effort has manifested itself in the form of technical committees. However, limited observation of the functioning of such committees indicates that a lack of an action agency and finances limit their effectiveness.

Well-recognized human limitations in the field of research are:

1. Inability to detect and select problems with far-reaching fundamental implications.
2. An inclination to tackle a problem without clearly defining it and considering all fundamental facts.
3. A lack of training in fundamental research methods and a lack of knowledge of research procedures.
4. A lack of balance between time for "activities" and time for "analysis." Primary causes for this condition are split interests plus the perpetual demand for quantity production and public contract.

Improvement in administrative planning can do much toward reducing these limitations.

* By L. W. Hurlbut, Member A.S.A.E., *Agricultural Engineering*, January, 1948. The four papers under the above title were presented at the annual meeting of the American Society of Agricultural Engineers at Philadelphia, Pa., June, 1947, as a contribution of the Power and Machinery Division. Mr. L. W. Hurlbut is Head, Agricultural Engineering Department, University of Nebraska.

It is a well-recognized fact that quality research cannot be had without a clearly defined quality problem. In my opinion, the recognition of problems embodying broad and fundamental implications will result from logic applied in one or more of the following general problem areas.

I. A Study of Potentialities of Areas.

Agricultural research proposes to improve rural life, promote the prosperity of agriculture, and contribute to the welfare of society as a whole. Therefore, a need exists for analyzing the economy of sizable areas in the light of their resources and opportunities. Evaluation of the importance of natural resources, crops, and industries which have a sound functional relation to the economic, social, and agricultural situation in a given area is the first step.

Careful consideration must be given to programs which will contribute to creative and profitable employment in these areas. The sociological, psychological, strategic, as well as economic aspects of rural living deserve further fundamental consideration before we become too soundly convinced that we are committed to large land units under one ownership. Engineering developments can exert tremendous forces in either direction. We want it to be the proper direction. In other words, we need research of a very broad nature to guide the functional type of research.

II. An Analysis of Potentialities of Enterprises.

Much of the value of research comes from increasing efficiency and reducing the unit cost of production. In the field of power and machinery, we have taken large and rapid strides in the mechanization of "hand methods" and "horse methods" of production. Opportunities for improvement in the future will become apparent through analysis of the potentialities of production enterprises. For example, we have mechanized corn production following the pattern long established by the hand and animal modes of production. We need to know more about the possibilities of growing a heavy population of smaller corn plants yielding small ears which can be harvested with a combine harvester. Such a plan implies increased yields, lower production costs by way of less cultivation, increased use of equipment, fewer harvesting machines, and the simplification of farm storage problems. We need fundamental facts which will permit us to substitute sound overall planning for custom and prejudice. Similar potentialities exist in all other production enterprises.

In addition, we need to rationalize the farming techniques in terms of standards which will provide a basis for a quick and accurate determination of the amount of work required for highly efficient farm operations. By such standards it would make possible reasonably accurate comparisons of efficiencies of labour and machinery without detailed account keeping. Such standards would do much to reduce the farmers' huge mechanical-agricultural-economic problem and permit them to concentrate on investment ceilings instead of only "machinery costs."

III. A Detailed Analysis of Production Methods.

A study of production equipment for the farm divides into three natural areas, namely,

1. Analysis of operations.
2. Determination of design requirements.
3. Power and machinery management.

The basic objective in agricultural production is increased efficiency with lower unit production cost; yet the acceptance of technological developments by the farmer has been disappointingly slow. This condition extends a challenge to public agencies and industry to find out why the beneficial developments have not been more widely sought.

Analysis of Operations.

An analysis of operations will undoubtedly provide fundamental facts to help answer the perpetual and important question: "Why has not farm mechanization been more effective in raising our overall farming efficiency?" Unquestionably there is operational inefficiency resulting from a lack of harmony between field machines, hauling units, and storage units. We have done much to improve the efficiency of individual machines, but relatively little toward developing efficient and harmonious systems for production.

Other important problems in this area are as follows:

1. We need methods of tilth measurement which will enable the objective evaluation of the functioning efficiency of tillage machines and methods. Up to 30 hp-hr are expended per acre manipulating the soil by plowing to produce the mysterious condition described as tilth; then we continue with other operations of questionable value which partially or wholly destroy the mysterious thing we set out to build. There is a wealth of information relating to mechanics and metallurgy, paralleled by much information on soils and plant physiology but the abysmal space separating the two fields remains. This problem serves to illustrate that agricultural engineering is not primarily the older sciences of engineering and agriculture put to work in agriculture. Agricultural engineering must embody new fundamentals and techniques designed to meet the unique requirements of agriculture. We are late in joining with other agricultural sciences in the study of root ecology which will furnish the facts for establishing the functional and design requirements for mechanizing tillage operations correctly.

2. Develop a new scale by which to measure the overall efficiency of crop production. This new scale must be based upon the accurate evaluation of all the components of the crop and methods used. Facts recently gained from studies of hay production have clearly shown the error of merely mechanizing an operation and neglecting the quality of the product. The loss in nutritive value of hay through present methods of handling, preserving, and storage is astounding.

3. Obtain more facts regarding fertilizer requirements and field placement requirements for the various crops. In my opinion this is not a study to be conducted independently by the agronomist.

4. Establish limits on seeding requirements for various crops. Such limits would provide basic design information as well as serve as a guide for the standardization of seeding machines.

5. Analyze the methods used in harvesting crops to determine whether or not the efficiency of machines and methods might be improved. For example, the harvesting of sorghum seed at safe storage moisture presents a problem because of the after-frost harvest periods. Preliminary tests indicate that the upper stem of the sorghum plant can be killed by passing a small but intense flame across it. A dry head on a green stalk may make possible the harvest of dry seed from a green plant.

Determination of Design Requirements.

Public agencies can serve best in this area by conducting exploratory research involving broad changes in conventional machines or procedures. A few specific problems which deserve consideration are as follows:

1. The development of a lubricating system, or oilless bearings, which will require attention not more than once per week, or, better yet, once per season.

2. Incorporate built-in storage features in agricultural machine design. Such features would eliminate the necessity for machine sheds.

3. Objectively evaluate the fundamental factors relating plant production and soil packing by field machines.

4. Determine the draft, speed, and shock relationships for various field machines.

5. Analyze collectively the harvesting operations involving all crops to determine their points of similarity or difference based upon unit operations. The general similarity of units involved in this group of machines suggests the possibility of a machine which would, with minor changes, harvest and process all the grain and hay crops. Also, consideration should be given to the use of the product and desirable changes in plant characteristics.

Power and Machinery Management.

This perpetual problem is one of operating existing tractors and machines at the greatest economy and efficiency for which they are built. This involves matching farm equipment types and sizes to job requirements, speed adjustment, loading, service routine, selection of lubricants and fuels, sequence of operations, working when conditions are favourable, and many other factors influencing cost and value of work done. Farm practice research involves much work, planning, and equipment, but offers a great opportunity for both quantity and quality results. A perpetual demand exists for more basic data for formulating principles and guides for obtaining more effective use of equipment on any specific job. Mechaniza-

tion alone is no complete or sure-fire means to material prosperity. More specific problems in this area are as follows:

1. The problem of broadening the field for the use of the tractor deserves attention. Herewith we need to determine the relative values for some of the most important units of complimentary equipment for the tractor, including the belt pulley, the power take-off, the power lift, hauling equipment, loading equipment, etc.

2. Develop a more rational basis for selecting machines and power units. This problem demands more fundamental facts relating the value of timeliness and quality coupled with a statistical analysis of the time in days or hours available for doing the different jobs under favourable conditions.

3. Determine the potential demand for a reliable local farm service in relation to various degrees of diversification in the principal farm enterprises with the view of eliminating labor peaks, securing high quality help, and simplifying the machinery problems.

4. Development of management practices which will utilize fully the labor-saving features of farm machinery and power.

The farmers of to-day and of the future are committed to mechanical farming. Their success depends to a considerable extent upon the correct selection and effective use of their power and machinery. More knowledge of the technological developments in this field is a vital need for them.

SOME MODERN METHODS OF TEA MANUFACTURE*

Since European capital first became interested in the cultivation of tea there have been few radical changes in the process of manufacture.

Much attention has been paid to field work, and the development of the agriculture of the industry. Plant physiologists have discovered the best varieties of bush for cultivation in the various countries and at different altitudes, and soil chemists have evolved the correct manurial doses, but little or no time has been devoted to discovering why the leaf was treated in a certain way once it left the field, or to determine if other methods could produce the same or even better results.

Withering, rolling, fermenting, sorting, have all been carried out according to fixed rules laid down a century or more ago. Each process had its enthusiastic protagonists who claimed that in the proper application of one or other of the processes lay the secret of good tea making. Good tea is made or ruined in the withering loft, says one; long hard rolling is the only way to get good liquors, says another. Slow fermentation say some; rapid fermentation claim their opponents. And so it has gone on until the manufacture of tea has become looked upon as an art instead of the science it in reality is. The man who should be able to tell us the why and the wherefore of the different processes, the chemist, was never consulted. One thing upon which all were agreed was that all the processes were essential, and that the machinery invented one hundred years ago was the only machinery that could be used to produce the "Cup that cheers but does not inebriate."

"The cup that cheers"!! Whom does it cheer? The man or woman that drinks it, in other words, the consumer.

With the majority of world products the one who calls the tune is, or ought to be, the consumer; the man who pays for it, and it is the duty of the producer to satisfy his requirements. But what are the requirements of the consumer of tea? According to long accepted principles he wants a good cup of tea at a reasonable price, varying in strength and flavour according to the part of the world in which he lives. But he also requires, or so we are led to believe, an attractive looking tea. That is to say, he demands that the few dried leaves from which he brews the beverage he drinks shall conform to certain standards of appearance.

Why should this be so? Except for coffee and tea, all other beverages and drinks are supplied to the consumer ready to drink, or in a condition vastly different from that of their basic constituents. The consumer is not a bit interested in whether the malt and hops from which his beer is brewed are nice looking malt and hops. The same can be said of all drinks,

* By R. Shaw, *Chronica Naturae*, Vol. 104, No. 3, March, 1948.

whether alcoholic or not. We pay for the taste and quality of the liquid we drink, not for the appearance of the products from which it is brewed or distilled.

But is the consumer so very interested in the appearance of dry tea, or has he even any knowledge of what so-called good tea should look like? We, the producers, are told so, and endless time and money is spent on producing pretty, attractive teas. They must be "true" grades, even in size; or they must be tippy, or wiry, or well twisted. They must contain no stalk, or "flats." Truly beautiful teas leave our factories; but what reaches the consumer? Our beautiful, carefully graded teas are cut and pounded and mixed into the greyish, unattractive, uniform commodity, in the colourful package, that the grocer hands across the counter when the housewife does her weekly shopping.

And does the housewife demand that the package be opened before she buys, and complain of the lack of tip, or the number of "flats," or the presence of stalk, or the lack of "twist"? No. She judges her tea by the excellence of the brew she gets in the pot, or the number of cups she can get from a quarter pound.

Can these last two requirements be filled by teas radically different in appearance from our Flowery Orange Pekoes, our Souchongs, our B.O.P.s etc.? Can they be filled by quicker and cheaper methods than those which have been in force since the industry was born?

The answer to both these questions is yes. Excellent tea liquors, better in quality and flavour than those to which we are accustomed, can be produced in much less time than heretofore, and in factories costing a fraction of the capital outlay of the old-style building.

Recent investigations into the chemistry of tea have shewn that little or no chemical change takes place in the leaf as the result of the process of withering. Good withering has been glorified into the "*ne plus ultra*" of successful tea manufacture, and yet all it achieves is to get the leaf into a condition in which it can be satisfactorily rolled in what must be the most cumbersome and inefficient machine that has ever been devised for a major industry.

What are the requirements for a good liquoring tea, flavour and quality being dependent on altitude and location? An efficient disruption of the leaf cells, and expulsion of the essential oils and juices so that exposure to the air can promote enzymic activity and oxidation. So far this has been achieved by the use of the pressure cap roller, the batteries of which take up so much room in our factories, and for the servicing of which so much labour is required. But the pressure cap roller has now been shewn to be an impostor. Its use impeded more than assisted the prime requirements above mentioned. The maximum pressure that it is possible to exert with the orthodox pressure cap roller is no more than 1 lb. per sq. in., and however long this pressure is applied no more than 20 per cent. of the leaf cells are disrupted. The only positive result of rolling was the

twist applied to the leaf, and in fact, an imprisonment of the essential oils within the twist, and to get leaf into the physical condition suitable for this highly inefficient process it was necessary to build towering lofts, with expensive and complicated air-flow and conditioning systems, in which the leaf was spread with much labour, and anything from 8 to 18 hours later was again collected for charging into the rollers.

Two methods exist for the manufacture of tea from unwithered leaf, and both produce teas which, though unorthodox in appearance, possess liquoring qualities far in advance of normally made teas without any loss in flavour or quality or character. One is already used commercially in North India, and involves a very short roll in open top rollers, while the other, which is still in the experimental stage, dispenses with traditional rollers altogether.

Let us first examine the method already in use on a commercial scale and which the writer has had the opportunity to see in operation. There are one or two variations of the process, but the principle of all is the same, and is namely, the shredding of the green leaf.

So far no engineering firm has produced a machine specifically designed for the processing of tea leaf, so use has been made of a machine borrowed from another industry, the tobacco cutter or shredder.

Two types of cutter have so far been used for tea manufacture, the Legg, and the McKerchen, and it is the former that the writer has seen in action. The principle of both is the same, however, and that is the complete disruption of the cells of the tea leaf, and the consequent release of the enzyme bearing oils and juices. Neither would appear to be ideal for tea, and the writer is convinced that it would be a small matter to develop a machine more suited for tea manufacture, but as an expedient they have been entirely successful and excellent results have been achieved.

The Legg cutter is a powerfully built precision machine which acts on the principle of the farm-yard chaff cutter, but in which very fine adjustments can be made to produce shreds of almost any desired size. It consists of a feed box along which the leaf is carried at low speed on an endless belt conveyor to a pair of cylindrical rollers, between which the leaf mass is forced onward under pressure to the cutting knife which operates in a perpendicular plane on the principle of the guillotine. Adjustments are possible to rate of feed, pressure, and closeness of cut, but the one seen operating had an hourly capacity of 240 lbs. green leaf with the knife speed set to 140 cuts to the inch. This produced a shred comparable in size to shag tobacco, from which it will be understood that very few leaf cells escape disruption.

Leaf is fed to the machine directly on arrival from the field, surface moisture being adequately removed by the pressure exerted by the feed rollers. The leaf emerges bright green in colour on which the bluish tinge of essential oils is visible when observed against the light, and is spread fairly thickly on trays until a sufficient quantity has been cut to form a

charge for a roller. Fermentation starts almost at once, and the colour of the leaf changes almost before one's eyes. A light charge of 200 lbs. is sufficient, and this is rolled in an open-top, preferably single-action roller for 15 to 20 minutes. This ensures an even distribution of the juices, and also helps to produce a tea more in conformity with present day market requirements as regards appearance.

It will be seen that one open-top roller can handle three charges of 200 to 250 lbs. per hour, or the capacity of three Legg cutters. After rolling, no longer than ten minutes is necessary to complete fermentation, after which the tea is dried at a slightly higher temperature than is the case with withered leaf, 220°F at intake being necessary to evaporate the surplus moisture. Little sorting is required, and only two grades emerge, a B.O.P. and a B.O.P. Fannings. There is no dust and no inferior grades.

The resulting teas are slightly brownish in colour, and while the B.O.P.F. approximates a true grade, the B.O.P. is somewhat light and feathery. No special care is required in plucking, and it is not necessary to sort out coarse leaf and stalk prior to manufacture as all is shredded to the same size and an even colour results. Some fine tip is visible.

The infusions and liquors are outstanding, and for this reason teas manufactured by this method have always realised prices far in excess of normal teas when offered for sale on the open market. Another feature is their economy in use. Owing to the very complete disruption of the cells and expulsion of juices on to the leaf surfaces much less dry tea is required to obtain a strong brew. At the same time it will be realised that very little liquor remains in the leaf after the first infusion.

Let us examine the advantages of this method of manufacture. First, cheaper plucking, as no green leaf sortation is required. Second, no withering. The saving here is enormous, both in capital cost of withering lofts, and in time and labour saved in daily working. Third, rolling time and labour reduced to a minimum; in new factories saving of capital as fewer rollers are required. Fourth, sortation simplified, and no inferior grades to be dealt with.

The whole process can be completed within two hours of the arrival of the leaf at the factory, whatever the weather.

Using a machine originally designed for another purpose, the disadvantages are twofold. One: the slowness of the run-through with the Legg or McKerchen cutters, necessitating at least four such machines for an estate with an annual crop of 1,000,000 lbs. Under present arrangements the allocation of Legg cutters for the Far Eastern tea industry is only twelve for the whole of 1947, so that until this restriction is raised there is small hope of equipping many factories in this way. As a matter of interest, to-day's price of a Legg cutter including knife sharpener is £1,000, compared with £650 for a normal tea roller.

The second disadvantage is in the packing. The feathery nature of these teas reduces the capacity of the standard tea chest by upwards of

10 per cent. This also applies to the packets used for retailing, and buyers complain that present packeting machinery cannot be adjusted to allow for this.

The second method of green leaf manufacture of tea is an adaptation of the Clivemear method, and is still only in the experimental stage, but it is worthy of interest, because from it developed the controversy over Tablet teas.

The Clivemear roller was originally intended for use with withered leaf, and in conjunction with a short spell of normal rolling, much as is done after Legg cutting, and was designed to apply that pressure to the leaf, and achieve a disruption of the cells that the normal pressure cap roller so dismally fails to achieve. It is also a precision instrument, and consists essentially of two stainless steel cylindrical rollers mounted in the same way as the rubber roller of a domestic clothes mangle. With the rollers set to a gap of 10/1000 in., withered leaf was passed between them and was subjected to an intense nip without materially altering its appearance. The nip, however, was such that a very complete breakdown of cells resulted. A short roll in an open-top roller was again sufficient to complete the process and also to impart a traditional appearance to the teas. Teas have been made on a commercial scale by this method and fetched satisfactorily high prices as long ago as 1938, when a few breaks were sent to the London Market from the St. Coombs Estate of the Tea Research Institute of Ceylon.

It is by means of the Clivemear roller that the second method of green leaf manufacture is carried out. In experiments carried out at the Tea Research Institute the gap between the rollers was reduced to 1/1000 in. and unwithered leaf was passed through. The result was a mass of pulp in which the optimum in cell disruption and juice expulsion had been achieved. This mass can be aerated to produce a very complete fermentation, and when dried fulfils the two most important of the consumers' requirements, a product from which very good tea can be made at a proportionately reasonable price.

At first, after drying the pulp, it was compressed into cakes which could later be broken down, blended, and re-compressed into tablets. Tablet teas received a lot of very unfortunate publicity when first presented to London brokers, and it seemed as if this revolutionary idea was strangled at birth. In the writer's opinion the strangling process was not as successful as might have been thought and there is still a spark of life in the "baby," which with care may still be raised to a lusty manhood.

After the initial failure of tablet teas attention was turned to the production of more marketable teas from this pulp mass, and it was found that a passable imitation B.O.P.F. and Dust could be turned out readily. Their unorthodox appearance is discounted by their exceptional liquoring qualities, and samples have been very favourably commented upon by prominent London buyers.

Here then are two methods by which tea, an excellent cup of tea, can be produced within two hours of the arrival of the green leaf at the factory. They are not traditional; they are not orthodox; but they are a solution to the ever mounting costs of both materials and labour in the tea producing countries, and what is more, they more than meet the requirements of the consumer.

Opposition is bound to be met, both from the brokers, whose very existence depends on the number of varieties and grades that can be produced, and from the manufacturers of tea machinery, but the tea plantation industry is bigger than either of these, and its existence depends on producing at reasonable cost something from which good tea can be brewed. Development of such methods would seem to be of paramount importance for Indonesia, particularly for those estates on which the factories have been wholly or partially destroyed.

Many estate owners, however, who find their pre-war factories more or less intact, will be loath to scrap them and embark on a system of manufacture involving the purchase of new machinery. For them the problem will be to reduce costs of manufacture following old and tried methods, and continuing to use existing machinery.

If lofts are still standing, and it is decided to carry on with the withering of leaf, little saving can be effected here. Drying is the one process which must take place whatever methods are followed. There remains rolling and sorting.

It has been pointed out that the pressure cap roller fails dismally in its task of breaking cells and expelling juices. The rolling systems in vogue before the war were long and complicated and necessitated much attention if they were to be carried out correctly. Five or six rolls entailed five or six ball-breakings and so on. With their caps they were unhandy to charge, and they did not do their job.

A solution to most of these shortcomings has been the development of "Cone" or "Epicyclic" rollers. "Cone" rolling is the result of experiments carried out to determine the best type of battens for use in normal rollers to impart twist to the leaf. In the course of these experiments it was discovered that the greatest amount of wear and tear on the roller table occurred in the centre, and that the further away from this central zone of activity the less the wear, to a very marked degree. It was from these findings that the use of the central projection, now known as the "Cone" was developed. The full scope of these experiments, which were long and exhaustive, can be found in Appendix No. 11 of the writer's "Report on a Visit to the Tea Districts of Ceylon, 1946-1947." Suffice it here to say that the Open-top Epicyclic Roller is slowly superseding the pressure cap roller in Ceylon, and is doing better work much more cheaply than the old style roller.

A favourable aspect of this new development is that any old type circular jacket roller can be converted to a Cone roller, thus obviating the necessity of purchasing new machinery.

The advantages of this type of roller can be summarised as follows.

- (i) Leaf chutes from the lofts can lead directly into the open top of the roller, thus saving much labour and leaf trampling.
- (ii) The pressure exerted on the leaf between the cone and the jacket is far greater than any pressure that can be exerted by a cap, but turbulence is maintained.
- (iii) 3 x 20 minutes is more than sufficient time to complete rolling.
- (iv) Fewer rollers are required (see iii).
- (v) New rollers of this type are cheaper than the pressure cap type.
- (vi) The elimination of the pressure cap and its constant operation makes it possible for one man to attend two or more rollers.

As with any method that speeds up processing time it must be borne in mind that drier capacity must be increased to cope with the faster flow of leaf.

Further economies that can be effected in orthodox and traditional tea manufacture are in the sorting, but they can only be applied where several estates are prepared to co-operate, or where one firm owns a group of estates at no great distance from each other. They are achieved by setting up a central sorting and packing factory, to which the unsorted teas from the estate group are sent for the final processes; this is already in practice in East Africa where considerable saving in manufacture costs and factory building costs have resulted. An advance on this has been suggested by an American buyer who asks why tea factories trouble to sort teas into grades which later are rebulked and cut in the packing houses, and suggests that tea be shipped unsorted from the producing factories.

Notes and Comments.

RICE CROP. SEASON 1947-48.

Final returns have not yet been received from all States but present indications are that the total crop will be the equivalent of 340,000 tons rice as compared with 257,164 tons for the season 1946-47, an increase of approximately 83,000 tons.

In calculating the rice equivalent of the padi crop, a conversion rate of 635 gantangs = 1 ton rice has been used instead of the former rate of 666. This increase is due to the higher milling recovery of 63 per cent. as compared with 60 per cent. in previous years. This altered conversion rate accounts for an increase of approximately 16,000 tons.

The total area to be harvested this season exceeds the 1946-47 season by approximately 65,000 acres which would account for an increase of approximately 26,000 tons.

The most important factor responsible for the very substantial increase in crop is the considerable increase in average yield of wet padi per acre from 222 gantangs in 1946-47 to 260 gantangs in the present season, an increase of 17 per cent. or approximately 41,000 tons rice.

To summarize the above:

	Tons.
Increase due to better milling	16,000
„ bigger acreage	26,000
„ higher yield	41,000
Estimated total increase	83,000

A final report on the 1947-48 season will be published in the October issue of this Journal.

PADI PURCHASE PRICE.

It was officially announced by the Government of the Federation of Malaya that from the 1st July, 1948, the Government guaranteed price for padi would be reduced from the former price of \$20 per picul at the mill and \$19.20 in the field to \$15 per picul at the mill and \$14.20 in the field. This price will remain effective until 30th June, 1949.

With effect from the 1st January, 1947, the Government guaranteed a minimum price of \$20 per picul at the mill. This was intended to be an incentive to padi planters which would enable them to rehabilitate themselves despite the increased costs of consumer goods. In 1947 the Government purchased padi to the equivalent of 55,000 tons of rice and sustained a loss of \$260.33 on every ton of rice sold at the rationed price. In 1948 consequent upon changes in the Rice Milling Contract and the increase in

price of rationed rice to the consumer, it is estimated that, were the guaranteed price maintained, a loss per ton of \$150.83 would be incurred. On an estimated purchase of 75,000 tons the subsidy required from public funds in 1948 would be \$11,312,250.

The Government can no longer afford such a heavy subsidy and has therefore decided to reduce the minimum price to \$15 per picul which it is considered gives a reasonable return to the producer under present conditions.

THE CENTENARY OF THE OIL PALM.

In the month of February of the year 1848 two tiny oil palms reached the Botanic Gardens at Buitenzorg from Bourbon or Mauritius, and in March of that same year two more from the Botanical Gardens at Amsterdam.

These four plantlets were the ancestors of all the oil palms now producing palm oil in the State of Sumatra's East Coast and in Malaya.

When in 1910 or thereabouts the commercial oil palm cultivation began, no one could foresee its remarkable development.

It is not often that one can celebrate a botanical centenary. But this one is all the more remarkable through having become a highly important commercial success. Let us see what the next centenary of the oil palm may bring.

The Economic Review of Indonesia, May, 1948.

AGRICULTURAL PRODUCTION, FEDERAL INDONESIA.

The following table, published in the Netherlands-Indonesian News Bulletin, 8th July, 1948, gives the present production capacity of the whole of Federal Indonesia, as well as the estimated production figures for 1948, 1949 and 1950, for certain agricultural crops.

Product	Capacity	1948	1949	1950
Rubber ..	315,000	90,000	180,000	220,000 tons*
Tea ..	60,000	10,000	25,000	45,000 "
Coffee approx.	18,000	9,000	12,000	15,000 "
Cinchona ..	unknown	500	600	600 "
Cocoa approx.	1,500	400	800	1,200 "
Palm oil ..	160,000	50,000	110,000	150,000 "
Sugar ..	—	50,000	300,000	500,000 "
Deli tobacco ..	—	1,000	5,000	10,000 "
East Java tobacco ..	—	1,000	3,000	5,000 "
Fibres ..	—	9,000	12,000	15,000 "

* allowing for an estimated international restriction of 30 per cent.

Departmental.

FROM THE DISTRICTS

*Compiled by the Chief Field Officer from Monthly Reports of
Agricultural Officers.*

March, April and May, 1948.

The Weather.

Hot and dry weather prevailed in the north, except in the extreme west coast areas where well-distributed rain fell during late March and early April. This, however, did not apply to Perlis, where drought conditions prevailed during this period. In the centre and south, wet weather was recorded and flooding occurred in several areas. During April, excepting areas in Perak, Negri Sembilan and Johore, where heavy rains fell, precipitation generally was below average, and hot and dry weather was experienced in most parts of the country. The month of May brought no great change in climatic conditions, and the wet weather in the south and dry conditions in the north still continue.

Crop Reports.

MAIN CROP—PADI.

Harvesting of the long-term wet padi crop was well advanced in March and by the end of May was virtually completed, except in those areas where planting was delayed. In Province Wellesley the final harvest yield was estimated at 13,110,000 gantangs, as compared with 8,840,240 gantangs for last season. The present season's yield equals about 335 gantangs per acre. Since harvest, cultivators have been extremely busy planting an off-season short-term padi, and already there is a substantial area under cultivation. The Department, working in conjunction with the Drainage and Irrigation Department, are up to schedule with numerous major and minor irrigation schemes which will be a great help in improving existing padi lands as well as bringing under padi several thousand new acres.

In Kedah the distribution of bat guano got well under way and to date over 650,000 gantangs have been issued to cultivators.

Padi cultivators in Pahang and Trengganu intend planting the main wet padi crop early this year to avoid a recurrence of the damage to padi crops during the November and December floods of last year.

Government rice mills in Krian, Perak, have so far purchased 320,000 piculs of padi, as compared with 119,191 piculs for the corresponding period last year. Government, however, has now decided that the guaranteed price of \$20 per picul will be reduced to \$15 per picul as from 1st July, 1948. A very considerable amount of padi seed has been issued by the Department,

the bulk of these supplies going to areas which suffered a poor harvest owing to the recent floods.

Towards the end of May, in the north, considerable difficulty was being experienced with the cultivation of padi lands due to the prevailing unusual and severe drought conditions. In some areas of Kedah, cultivation work was suspended entirely.

In the south, however, during this period floods caused damage to nurseries, particularly in the Jasin area in Malacca, where the Kesang River overflowed its banks; the losses have since been made good.

FOODCROPS.

Good progress was made during March with the planting of off-season vegetables and foodcrops on padi land, and a substantial increase in the acreage over last year is certain. The dry weather from April onwards in the north has held up progress.

Prospects were bright for a good water-melon harvest in Perlis, but due to an unidentified disease the crop failed badly in many areas. On the other hand in Kelantan and Trengganu a good crop was harvested.

In Selangor and Negri Sembilan, the cultivation of bitter cucumber is rapidly increasing and several thousand piculs were harvested.

In Province Wellesley and Trengganu crops of leaf vegetables have been unusually good, with the result that prices have been low. In Negri Sembilan, however, where rain adversely affected production of leaf vegetables, prices rose.

RUBBER.

During March and April prices were generally steady except in Kelantan and Malacca where a slight rise was recorded. In May, however, a general rise in prices for all grades of rubber was reported from all over the country. Rubber buyers are now giving a high premium for good quality sheet, and this has acted as an incentive to small-holders to produce better quality rubber.

In Johore small-holders are now showing a greater and keener interest in improvements to their holdings, particularly in drainage conditions.

The importance of budding which is now becoming more and more appreciated by small-holders resulted in budgrafting schools for small-holders being instituted in Province Wellesley and Kedah, and excellent progress has been made.

The Department of Agriculture and the Rubber Research Institute recently co-operated in Malacca in a scheme to assist small-holders in the Settlement to bud their rubber seedlings in the field with budwood from high-yielding clones. Over 10,000 successful buddings were made on 20 Malay and 13 Chinese small holdings at a cost to the small-holder of 6 cents per successful bud inclusive of budwood.

Now that the padi harvest is more or less over, small-holders are finding more time to devote to rubber tapping, and as a result tapping is on the increase.

In Perak North, in an area where rubber trees had been heavily attacked by termites (white ants), treatment with mercury perchloride solution was carried out with success.

In Selangor two more co-operative smoke-houses are under construction at Klang.

COCONUTS.

The general shortage of coconuts for copra production was evident, so much so that copra production in Trengganu came to a standstill. In Kedah, however, the coconut industry is in a favourable position, but there was a slight drop in quotations for copra due to the closing down of most of the oil mills in Penang. The price, however, did not fall as there is a good local demand. In Johore, there was a distinct drop in the prices of copra mainly due to the restrictions on exports to Singapore.

Agricultural Stations.

At Tanjong Malim, in Perak South, a demonstration plot has been prepared for the planting of demonstration fruit trees for the benefit of the local inhabitants.

In Changkat Jong, Perak South, a suitable site has been chosen and work has already started on clearing the site which will be devoted entirely to the demonstration of padi cultivation and of the correct methods of spacing bunds.

Destruction of Agricultural Pests.

More Government-purchased shotguns have been issued for the protection of foodcrops, and results of the increased drives against pests have been excellent. Shooting of wild pig is definitely the most popular and efficient method of dealing with this pest. Next to that in popularity is trapping. The rat destruction staff of the Department have been vigorously attending to the destruction of these obnoxious rodents and giving lectures and demonstrations to cultivators, who are now beginning to realise that pest destruction on their holdings is of primary importance. Yet another pest doing considerable damage to coconuts, fruits, etc. is the squirrel and drives to eliminate this pest are being organised.

The following figures represent the number of known kills in the first 5 months of the year. The full figures are undoubtedly far in excess of these since private hunting parties and cultivators do not report their kills.

Wild pigs	.. 34,053	Squirrels	.. 29,766
Rats	.. 147,079	Other pests	.. 7,714

DEPARTMENTAL NOTES

Retirement of Mr. F. Burnett, C.B.E., M.C., M.A.

Mr. F. Burnett, Director of Agriculture, Federation of Malaya, left Malaya on leave prior to retirement on the 21st May, 1948.

Mr. Burnett came to Malaya in November, 1945, to re-organize the Department in the difficult post-war period. He was transferred from Jamaica where he had been Commissioner of Lands.

During Mr. Burnett's tenure of office a great deal has been accomplished by the Department in spite of a serious shortage of senior officers. In the early post-war months major attention was paid to the "Grow More Food" campaign, and in 1947 the separate Short Term Food Organization was transferred to the Department and came under the direction of Mr. Burnett. The most noteworthy achievement of the past two years has been the increase in padi cultivation in Malaya, culminating in the past season in a record crop.

All his colleagues in the Department join in wishing Mr. and Mrs. Burnett a long and happy well-earned retirement.

Visit of the Adviser, Malayan Pineapple Industry, to the United Kingdom.

Mr. C. E. Courtenay, Adviser, Malayan Pineapple Industry, left Malaya by air on the 3rd June on an official visit to the United Kingdom to discuss problems connected with the industry. Mr. Courtenay returned to Malaya on the 29th June.

The objects of Mr. Courtenay's visit were as follows:—

- (a) To report to the Colonial Office on the progress made in resuscitating the Malayan canned pineapple industry, and explain the scheme which had been drawn up for its future development;
- (b) To ascertain the views of the Colonial Office and the Ministry of Food on the long term prospects for marketing the pack in the United Kingdom;
- (c) To negotiate a sale of the current pack to the Ministry of Food at prices approximating to the high costs of production.

Mr. Courtenay was successful in concluding a sale of 130/150,000 cases of canned pineapple to the Ministry for shipment during the period June 1948 to February 1949, and acquired valuable information as to the long term prospects of marketing Malayan canned pineapple in the United Kingdom. His visit to London has been of great benefit to the Malayan industry.

Appointments.

Dr. A. E. S. McIntosh, Deputy Director of Agriculture, has been appointed to act as Director of Agriculture, Federation of Malaya, with effect from 21st May, 1948.

Mr. R. G. H. Wilshaw, Chief Research Officer, has been appointed to act as Deputy Director of Agriculture with effect from 21st May, 1948.

Mr. A. Thompson, Senior Plant Pathologist, has been appointed to act as Chief Research Officer with effect from 21st May, 1948.

Mr. A. Johnston, Plant Pathologist, has been appointed to act as Senior Plant Pathologist with effect from 21st May, 1948.

Raja Mahmud bin Raja Ali has been appointed to act as State Agricultural Officer, Pahang, with effect from 12th April, 1948.

Mr. R. J. A. W. Lever, Entomologist, has been appointed to act as Senior Entomologist with effect from 26th April, 1948.

Mrs. M. Johnston has been appointed to the post of Botanist on a temporary basis with effect from 1st May, 1948.

Mrs. M. Lee has been appointed to the post of Senior Lecturer at the College of Agriculture, Malaya, on a temporary basis with effect from 1st July, 1948.

Dr. S. G. Willimott, who was seconded to the Department of Agriculture from the Department of Chemistry in May, 1947, has now been transferred to the Department and appointed Soils Chemist with effect from 19th November, 1947.

Leave.

Mr. H. T. Pagden, Senior Entomologist, has been granted 175 days leave, in addition to voyages, with effect from 27th April, 1948.

Mr. F. C. Cooke, Canning Officer, returned from leave on 4th May, 1948, and is stationed at Headquarters, Kuala Lumpur.

Resignation.

Mr. Choo Kok Leong, Vice-Principal, College of Agriculture, Malaya, resigned from Government Service with effect from 30th June, 1948.

Statistical

MARKET PRICES

June 1948.

Rubber.—The Singapore price of No. 1 R.S.S. Spot loose has shown a gradual improvement during the three months April, May and June from 41½ cents per lb. on 1st April to 46 cents per lb. on 30th June. On the last day of April the price was 41¾ cents and the average for the month was 41.74 cents per lb. There was a greater improvement in May and the month closed with the price at 44 cents per lb. giving an average price for the month of 43.48 cents. During June there was a further increase in price until as mentioned above, on the last day it had reached 46 cents, giving an average of 45.17 cents per lb.

The average prices paid in London and New York were: London, April 12.53, May 13.11 and June 14.00 pence per lb.: New York, April 23.00, May 23.36 and June 22.80 cents gold per lb.

The average price paid for small-holders' rubber at three centres during the second quarter of 1948 are given in Table I.

Table I.

Average Monthly Price Paid by Local Dealers for Small-Holders' Rubber, April-June, 1948.

(Dollars per picul of 133½ lbs.)

Grades	Kuala Kangsar, Perak.			Kuala Pilah, Negri Sembilan.			Batu Pahat, Johore.		
	Apr.	May	June	Apr.*	May	June	Apr.	May	June
Smoked Sheet ..	48.40	50.45	53.72	50.80	52.28	54.53	43.75	44.19	46.12
Unsmoked Sheet ..	39.75	42.90†	45.28	43.80	45.48	45.68	39.13	40.41	42.21
Scrap ..	22.75	22.75	25.00	17.00	17.00	18.00	14.58	14.81	15.21

Transport from Batu Pahat to Singapore by lorry, excluding duty, \$1 per picul.

* Figures for Seremban.

† Last two weeks only.

Tea.—The latest Colombo prices available quoted from "The Ceylon Tea Market Report" of 13th July 1948, of the Colombo Brokers' Association, are as follows, in rupees per lb.—High Grown Teas Rs. 1.61, Medium Grown Teas Rs. 1.36, Low Grown Teas Rs. 1.46.

There is, in addition to the above prices, an export duty of 38 rupees cents per lb. which is payable by the buyer.

The retail price of Malayan tea (Boh) is \$2 per lb.

Derris.—The price, as quoted by the Singapore Chamber of Commerce, remained steady through May, June and July at \$75 (nominal) per picul. Another report stated that prices improved during May averaging \$63 to \$65 per picul of 5 per cent. rotenone root content, delivered loose into Singapore godown, and advanced in June to \$64 to \$66 per picul.

Rice.—The Government controlled price of rice remains at \$30 per picul. The ration was increased at the end of May to 2½ katis per week, per person, being an increase of ½ kati over the previous month.

Padi.—The Government guaranteed price per picul of padi delivered at the mill has been reduced to \$15 per picul and for padi purchased in the field to \$14.20 with effect from 1st July.

Tobacco.—The price of No. 1 cured leaf in Kelantan in April was \$600 per picul, being the same as for the previous month. There was a decrease in May to an average of \$550 per picul, while the June prices varied from \$480 to \$620. The prices of 2nd and 3rd quality in May were \$350 to \$480 and \$220 to \$350 respectively, but showed a slight decrease in June, i.e. \$330 to \$475 for 2nd quality and \$200 to \$330 3rd quality.

Table II.

Singapore Prices of Various Agricultural Products.

Product	June, 1948			May 1948	April 1948	Average Price 1947
	Highest	Lowest	Average	Average	Average	
	per picul \$	per picul \$	per picul \$	per picul \$	per picul \$	per picul \$
Copra:						
Sundried No. 1 ..	44.50	43.50	44.38	43.96	42.73	21.28
Coconut Oil ..	79.00	76.00	77.84	78.24	74.81	35.49
Coffee:						
Padang Bali No. 1	143.00	123.00	138.38	130.04	99.46	109.10
No. 2	*	*	*	*	*	100.66
Palembang No. 1	77.00	77.00	77.00	77.00	75.10	65.13
Sourabaya No. 1	85.00	85.00	85.00	85.00	82.77	79.15
Pepper:						
Muntok White ..	179.00	170.00	175.65	167.04	160.00	124.65
Sarawak ..	178.00	169.00	174.65	166.04	159.00	116.85
Cloves:						
Indian ..	44.00	44.00	44.00	44.00	44.00	41.85
Sumatra ..	47.00	47.00	47.00	47.00	47.00	51.70
Gambier:						
Rounds No. 1 ..	125.00	125.00	125.00	125.00	125.00	130.81
No. 2 ..	*	*	*	*	*	115.68
Sago Flour:						
Lingga ..	22.00	18.25	19.34	17.92	17.35	16.25
Tapioca Flour:						
Malayan No. 1 ..	30.00	30.00	30.00	30.00	30.00	28.15
No. 2 ..	*	*	*	*	*	24.22

* Not quoted.

FEDERATION OF MALAYA **PRODUCTION OF PALM OIL AND KERNELS.**

(In long tons as declared by Estates)

MONTH	PALM OIL		PALM KERNELS	
	1947	1948	1947	1948
January ..	2,238.2	3,821.9	292.3	664.1
February ..	2,316.9	3,659.8	337.1	677.9
March ..	2,585.8	3,567.6	386.2	633.0
April ..	2,410.2	3,598.6	380.2	699.4
May ..	2,377.7	3,076.5	359.9	597.4
June ..	2,451.2	2,420.1	336.1	431.0
July ..	3,479.4		452.6	
August ..	3,558.5		551.0	
September ..	3,887.3		583.1	
October ..	4,465.0		635.9	
November ..	4,483.9		658.4	
December ..	4,860.9		764.4	
Total ..	39,115.0	20,144.5	5,737.2	3,702.8

In June, 37 estates (planted area 72,908 acres) were in production out of a total of 47 oil palm estates (planted area 78,665 acres), including an estate not previously registered.

MALAYAN AGRICULTURAL EXPORTS, **JANUARY-MARCH, 1948.**

Product	NET EXPORTS IN TONS.		
	Jan., Feb. & March 1947	Year 1947	Jan., Feb. & March 1948
Arecanuts ..	2,647	12,507	1,276*
Coconuts fresh† ..	6,790†	62,873†	11,661†
Coconut oil† ..	10,504	41,112	11,984
Copra† ..	7,847*	45,439*	14,117*
Copra cake ..	1,026*	5,260*	635*
Gambier, all kinds ..	222	1,156	6*
Palm kernels ..	937	5,245	1,449
Palm Oil ..	16,088	43,325	9,238
Pineapples, canned ..	493	2,611	974
Rubber¶ ..	161,355¶	645,229¶	171,076¶
Sago,—flour ..	188*	5,958	1,915*
" —pearl ..	1,976	2,404	1,755
" —raw ..	2,387*	6,415*	237*
Tapioca,—flake ..	33	52	16
" —flour ..	2,512	6,490	12*
" —pearl ..	562	7,205	1,650
Derris ..	173	243	29
†Copra equivalent ..	9,358	22,625	5,590

† hundreds in number.

* net imports.

¶ production (Federation of Malaya).

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

MONTH	ESTATES		SMALL-HOLDINGS (ESTIMATED)		TOTAL	
	1947	1948	1947	1948	1947	1948
January ..	25,822	34,668	26,748	27,321	52,570	61,989
February ..	26,633	28,529	23,370	22,121	50,003	50,650
March ..	27,552	31,888	31,230	26,549	58,782	58,437
April ..	25,300	32,724	24,323	33,684	49,623	66,408
May ..	29,127	33,294	18,009	16,313	47,136	49,607
June ..	30,717		22,028		52,745	
July ..	33,366		20,407		53,773	
August ..	28,514		20,537		49,051	
September ..	32,070		21,412		53,482	
October ..	33,078		31,844		64,922	
November ..	36,050		18,419		54,469	
December ..	31,636		27,037		58,673	
Total ..	359,865	161,103	285,364	125,988	645,229	287,091
Total 1946 ..	173,515		229,692		403,207	

Small-holding production is estimated from the formula: Production + imports + opening stocks = exports + consumption + closing stocks.

FEDERATION OF MALAYA RUBBER STATISTICS.

Acres of Tappable Rubber Actually Tapped and not Tapped on Estates of 100 Acres and over for the Month ending
31st May, 1948.

STATE SETTLEMENT	Estimated Acres of Tappable Rubber (9) + (11)	Acres of tappable Rubber not tapped				Area of tappable rubber never been tapped				Total Area not tapped (3) + (5)				Total Area tapped during the month				Area of tappable rubber rested under rotational systems			
		On estates which have entirely ceased tapping		On estates which have partly ceased tapping		Area of tappable rubber never been tapped		Area of tappable rubber never been tapped		Total Area not tapped (3) + (5)		Total Area not tapped (3) + (5)		Total Area tapped during the month		Total Area tapped during the month		Area of tappable rubber rested under rotational systems		Area of tappable rubber rested under rotational systems	
		Acres (3)	% of to (4)	Acres (5)	% of to (6)	Acres (7)	% of to (8)	Acres (9)	% of to (10)	Acres (11)	% of to (12)	Acres (13)	% of to (14)	Acres (15)	% of to (16)	Acres (17)	% of to (18)	Acres (19)	% of to (20)	Acres (21)	% of to (22)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
Perak ..	273,615	1,056	4	26,820	9.8	7,158	2.6	27,876	10.2	245,739	89.8	20,324	7.4	245,739	89.8	20,324	7.4	20,324	7.4	20,324	7.4
Selangor ..	328,176	943	3	26,012	7.9	6,921	2.1	26,955	8.2	301,221	91.8	19,645	6.0	301,221	91.8	19,645	6.0	19,645	6.0	19,645	6.0
N. Sembilan ..	260,603	2,145	8	37,955	14.6	10,129	3.9	40,100	15.4	220,503	84.6	11,032	4.2	220,503	84.6	11,032	4.2	11,032	4.2	11,032	4.2
Pahang ..	98,852	741	7	15,006	15.2	8,093	8.2	15,747	15.9	83,105	84.1	7,431	7	83,105	84.1	7,431	7	7,431	7	7,431	7
Malacca ..	120,024	3,918	3.3	13,077	10.9	3,975	3.3	16,995	14.2	103,029	85.8	6,595	5.5	103,029	85.8	6,595	5.5	6,595	5.5	6,595	5.5
Penang & P. Wellesley ..	28,436	234	8	3,057	10.8	718	2.5	3,291	11.6	25,145	88.4	4,669	16.4	25,145	88.4	4,669	16.4	4,669	16.4	4,669	16.4
Johore (d) ..	487,075	17,050	3.5	67,521	13.9	21,610	4.4	84,571	17.4	402,504	82.6	26,561	5.4	402,504	82.6	26,561	5.4	26,561	5.4	26,561	5.4
Kedah ..	199,393	531	3	14,835	7.4	5,030	2.5	15,366	7.7	184,027	92.3	27,383	13.7	184,027	92.3	27,383	13.7	27,383	13.7	27,383	13.7
Perlis ..	1,861	—	—	411	22.1	146	7.8	411	22.1	1,450	77.9	140	7.5	1,450	77.9	140	7.5	140	7.5	140	7.5
Kelantan ..	31,371	117	4	7,912	25.2	1,865	5.9	8,029	25.6	23,342	74.4	87	3	23,342	74.4	87	3	87	3	87	3
Trengganu ..	15,816	583	3.7	4,736	29.9	849	5.4	5,319	33.6	10,497	66.4	944	6.0	10,497	66.4	944	6.0	944	6.0	944	6.0
Total ..	1,845,222	27,318	1.5	217,342	11.8	66,494	3.6	244,660	13.3	1,600,562	86.7	124,761	6.8	1,600,562	86.7	124,761	6.8	124,761	6.8	124,761	6.8
Total April, 1948 ..	1,829,540	14,041	.8	230,058	12.6	71,707	3.9	244,099	13.4	1,585,441	86.6	128,384	7.0	1,585,441	86.6	128,384	7.0	128,384	7.0	128,384	7.0

Notes:—(a) Area out-of-tapping on estates which have partly ceased tapping refers to areas definitely being rested and excludes area on any tapping round.

(b) The acreage shown in column (7) is included in columns (3) and (5).

(c) Acres of tappable rubber rested under rotational systems are not considered as out-of-tapping and therefore columns (11) and (12) include columns (13) and (14) respectively.

(d) Registered estates only.

(e) This table was published by the Acting Registrar of Statistics, Federation of Malaya, on 24th June, 1948.

FEDERATION OF MALAYA
COCONUT OIL AND COPRA CAKE STATISTICS.
Production of Coconut Oil and Copra Cake, as declared by
Principal Oil Mills only.

(in tons)

MONTH	Copra Treated		Coconut Oil Expressed		Copra Cake (Poonac) manufactured	
	1947	1948	1947	1948	1947	1948
January ..	7,324	6,429	3,703	3,302	3,034	2,512
February ..	7,632	6,231	3,892	3,224	3,138	2,432
March ..	8,267	7,614	4,264	3,910	3,351	2,913
April ..	7,590	8,146	3,897	4,054	3,071	3,223
May ..	8,511	6,225	4,355	3,124	3,396	2,446
June ..	8,458		4,370		3,443	
July ..	9,408		4,808		3,826	
August ..	8,801		4,491		3,614	
September ..	8,902		4,554		3,651	
October ..	8,753		4,478		3,560	
November ..	8,518		4,329		3,454	
December ..	7,994		4,045		3,222	
Total ..	100,158	34,645	51,186	17,614	40,760	13,526

Direct Foreign Imports and Exports of Malaya
(Federation of Malaya and Singapore, excluding trade between these
two territories).

(to the nearest ton)

PERIOD	IMPORTS			
1948	Fresh Coconuts (numbers)	Copra	Coconut Oil	Copra Cake
May	2,000	8,618	209	—
Jan./May	39,360	34,966	2,579	482

PERIOD	EXPORTS			
1948	Fresh Coconuts (numbers)	Copra	Coconut Oil	Copra Cake
May	659,300	5,361	3,123	—
Jan./May	2,320,100	14,973	22,194	—

Notes:—(a) Details of small-holding production are not available.

(b) Production figures are as published by the Acting Registrar of Statistics, Federation of Malaya.

(c) Import and export figures are as published by the Acting Registrar of Malayan Statistics, Singapore.

METEOROLOGICAL SUMMARY, MALAYA, MARCH, 1948.

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LOCALITY.	AIR TEMPERATURE DEGREES FAHRENHEIT							EARTH TEMPERATURE		RAINFALL							BRIGHT SUNSHINE			
	Means of			Mean of A and B	Absolute Extremes			At 1 foot °F	At 4 feet °F	Total		Most in a day.		Number of days					Total Daily Mean	Per cent.
	A.	B.	Max.		Min.	Highest	Lowest							Max.	Min.					
																Thunderstorm	Fog morning obs.	Gale force 8 or more		
Ipoth, Perak	91.3	72.8	..	82.1	96	70	85	76	84.9	ins.	ins.	6.93	176.0	1.60	17	16	3			
Port Swettenham, Selangor	89.4	73.0	..	81.2	93	69	83	75	85.0	10.72	272.3	1.72	22	22	19	3				
K. Lumpur, Selangor	90.8	73.0	..	81.9	94	69	85	75	85.3	8.50	215.9	1.49	17	15	10	5				
Sitiawan, Perak	88.9	73.1	..	81.0	92	70	86	75	84.1	5.13	130.3	2.10	18	14	4	1				
Kuala Lipis, Pahang	89.6	72.0	..	80.8	93	69	81	75	88.6	9.89	251.2	4.15	11	9	4	16				
Kuantan, Pahang	87.0	70.8	..	78.9	91	68	78	74		10.75	273.1	6.81	14	10	1					
Bayan Lepas, Penang	88.3	74.4	..	81.3	91	73	82	78		10.03	254.8	4.26	16	13	4					
Malacca	87.3	74.1	..	80.7	91	72	82	76		7.24	183.9	2.08	18	13	1					
Mersing, Johore	85.1	72.8	..	78.9	88	71	77	78		11.42	290.1	2.11	15	14						
Alor Star, Kedah	92.4	72.5	..	82.5	97	69	84	75		5.29	134.4	2.51	14	9	2	1				
K. Trengganu, Trengganu	87.0	72.5	..	79.7	89	71	78	74		9.05	229.9	2.18	16	14	1	7	2			
HILL STATIONS																				
Fraser's Hill, Pahang 4268 ft.	72.5	62.0	..	67.3	76	59	65	64	71.1	7.57	192.3	0.80	25	19	3	18				
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	73.7	55.9	..	64.8	77	49	70	61	68.1	11.50	292.1	1.65	20	17		2				

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, APRIL, 1948.

LOCALITY.	AIR TEMPERATURE DEGREES FAHRENHEIT					EARTH TEMPERATURE PERATURE		RAINFALL							BRIGHT SUNSHINE			
	Means of			Absolute Extremes		At 1 foot °F	At 4 feet °F	Total		Number of days			Total	Daily Mean	Per cent.			
	A.	B.	Min.	Mean of A and B	Highest					Lowest	Min.	Max				Thunder-storm	Fog morning obs.	Gale force 8 or more
Ipoh, Perak	92.2	73.5	82.9	95	70	88	76			ins. 11.79	m.m. 299.5	ins. 2.56	22	16	9	1		
Port Swettenham, Selangor	90.9	73.4	82.1	93	69	88	75	86.9	85.6	4.79	121.7	1.31	12	9	2			
K. Lumpur, Selangor	91.5	73.2	82.3	95	70	87	75			11.50	292.1	1.93	18	16	9	3		
Sitiawan, Perak	90.4	73.2	81.8	93	71	86	75	85.9		8.37	212.6	2.63	14	13	5	1		
Kuala Lipis, Pahang	90.9	72.1	81.5	93	69	88	75	84.9	84.3	11.86	301.2	2.70	16	15	5	15		
Kuantan, Pahang	90.7	72.0	81.3	93	69	86	74			5.51	140.0	2.28	10	9	6	3		
Bayan Lepas, Penang	89.0	75.0	82.0	91	72	85	77			4.51	114.6	2.65	17	10	6			
Malacca	87.8	74.3	81.1	91	72	83	76			1.58	40.1	0.86	7	4	2			
Mersing, Johore	88.0	72.6	80.3	90	71	86	75			2.29	58.2	1.32	4	3				
Alor Star, Kedah	91.7	74.5	83.1	94	72	85	76			7.64	194.1	2.24	15	12	3			
K. Trengganu, Trengganu	89.6	73.9	81.7	92	71	87	76			3.55	90.2	2.20	4	4	1	1		
HILL STATIONS.																		
Fraser's Hill, Pahang 4268 ft.	74.6	63.0	68.8	78	61	71	65	72.1		7.94	201.7	1.66	20	17	5	3		
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	74.2	55.8	65.0	78	52	71	59	69.3		13.03	331.0	1.30	24	22	7	1		

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, MAY, 1948.

LOCALITY.	AIR TEMPERATURE DEGREES FAHRENHEIT					EARTH TEMPERATURE		RAINFALL						BRIGHT SUNSHINE						
	Means of		Absolute Extremes			At 1 foot of F	At 4 feet of F	Total			Number of days				Total	Daily Mean	Per cent.			
	A. Max.	B. Min.	Mean of A and B	Highest	Lowest						Max.	Min.	8 or more	Thunder-storm				Fog morning obs.	Precipitation .04 in or more	Precipitation .01 in or more
Ipoh, Perak	92.7	74.3	83.5	97	73	89	78	ins.	8.95	207.4	1.88	18	15	4						
Port Swettenham, Selangor	89.9	73.9	81.9	94	72	85	76	10.99	279.1	3.12	3.12	17	14	1	1					
K. Lumpur, Selangor	90.5	74.1	82.3	94	72	86	78	9.33	237.0	1.59	1.59	19	18	8	5					
Sitiawan, Perak	90.3	73.7	82.0	94	72	87	75	6.27	159.3	2.83	2.83	13	11	3	1					
Kuala Lipis, Pahang	90.3	72.9	81.6	93	70	82	76	12.92	328.2	2.93	2.93	13	13	6	19					
Kuantan, Pahang	86.9	72.7	81.1	92	71	78	76	6.41	162.8	1.31	1.31	21	15	5	7					
Bayan Lepas, Penang	88.8	75.4	82.1	92	69	84	78	5.47	138.9	1.11	1.11	19	13	4						
Melacca	86.8	74.7	80.7	92	73	78	78	7.94	201.7	2.29	2.29	16	12	4						
Mersing, Johore	89.0	72.6	80.5	92	70	83	77	3.65	92.7	1.67	1.67	13	9	2	1					
Alor Star, Kedah	90.8	75.2	83.0	93	72	88	78	2.21	56.1	1.14	1.14	12	9							
K. Trengganu, Trengganu	90.1	74.1	82.1	92	72	80	77	4.86	123.4	1.85	1.85	10	10	2	2					
HILL STATIONS. Fraser's Hill, Pahang 4268 ft.	75.0	63.7	69.3	78	61	72	66	7.75	196.9	1.42	1.42	21	21	4	7					
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	74.4	56.7	65.5	79	49	70	63	11.71	297.4	2.35	2.35	21	20	3	1					

Compiled from Returns supplied by the Malayan Meteorological Service.